

SURVEILLANCE OF INFECTIOUS DISEASES IN ANIMALS AND HUMANS IN SWEDEN 2013



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Introduction

Surveillance of infectious diseases in animals and humans 2013, is an 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. A difference from last year's report is that the chapter on Schmallenberg virus is no longer included, since the disease has become endemic in Sweden. A new chapter has also been added presenting the results of all passive surveillance investigations during the year. This was added to highlight the passive surveillance initiatives which are our chosen strategy for serious diseases including Foot and mouth disease, African swine fever and Anthrax.

Sweden has had a low burden of serious animal diseases for several decades. The high health status of Swedish animals has led to the official declaration of freedom from several infectious diseases, which are present elsewhere in the European Community. Sweden is at present considered free from bovine paratuberculosis and will likely soon be declared free from bovine viral diarrhoea.

The prevalence of *Salmonella* in food producing animals is, like in Finland and Norway, very low compared to most countries. This is illustrated by the low numbers of human cases of *Salmonella* caused by food produced in Sweden. During 2013 the surveillance of *Echinococcus multilocularis* has continued and the prevalence of the parasite is considered endemic at a low level.

Trade in live animals remains the greatest risk for introduction of new diseases to Sweden. Vectors play an important role in the transmission of infectious diseases to humans and animals. The reservoir for these vector borne pathogens is often found in wildlife, which makes surveillance and control challenging.

In order to improve existing surveillance, a national strategy for animal surveillance has continued to be developed. It is a tool for prioritising surveillance programmes and will gradually be implemented during 2015. The aim is to identify short and long term objectives and needs for animal health surveillance. In addition, strategic documents for important zoonoses such as *Salmonella*, *Campylobacter*, *Listeria* and *Yersinia* have been produced in collaboration with the Swedish Board of Agriculture, the National Food Agency, former Swedish Institute for Communicable Disease Control (currently the Public Health Agency of Sweden), the National Board of Health and Welfare and the National Veterinary Institute. The shared knowledge and analysis in the documents will serve as a basis for a common strategy to deal with these infections in humans and animals in the future.

The 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 those remaining have increased in size. The data below relates to the situation in June 2013. The slaughter figures cover the year 2013. Maps 1-3 and Figure 1 give an overview of the livestock population in Sweden.

CATTLE

There are 18,962 holdings with a total number of 1,496,500 cattle (dairy cows, cows for calf production, heifers, bulls, steers and calves younger than one year) in Sweden (Map 1).

The number of dairy cows has decreased over a long period of time. However, a slight increase was noted from June 2011 to June 2013. There were 344,000 cows in 4,700 dairy herds with an average of 73 cows per herd. The number of cows for calf production was 188,000 in June 2013 with an average herd size of 17 cows.

In total, approximately 392,000 adult cattle and 27,000 calves were slaughtered during 2013.

PIGS

The total number of pigs was 1,398,900 (Map 2) in June 2013, which is an increase compared to 2012. However, since 1995 the number of pigs has reduced by 40% and during the past 13 years four out of five holdings have closed down.

About 2,556,000 pigs were slaughtered during 2013. Of these approximately 49,000 were sows.

SHEEP

In June 2013, there were 8,817 sheep holdings with a total of 285,520 ewes and rams (Map 3). Sheep holdings in Sweden are usually small-scale enterprises with an average herd size of 32 adult sheep.

During 2013, approximately 253,000 sheep were slaughtered of which 218,000 were lambs.

GOATS

In 2013 the reported number of goats and goat holders in Sweden were 12,372 and 2,483 respectively.

POULTRY

The number of fowl has increased since 1995. In 2013 there were 6.9 million hens (chicken not included) in 4,148 holdings.

Eggs delivered to wholesalers amounted 103.4 million kilos during 2013 which is an increase compared to 2012.

The number of holdings in June 2013 with broiler production was 219 and about 81.8 million chickens were sent for slaughter during the year.

During 2013 452,000 turkeys were slaughtered, a decrease compared to 2012.

The production of geese and ducks is very small. In 2013, 15,806 geese and 1,334 ducks were slaughtered.

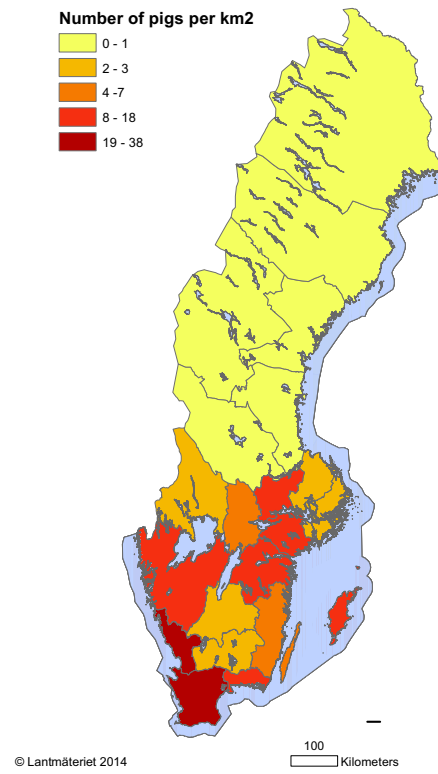
FISH AND SHELLFISH

Swedish fish farms are evenly distributed over the country with a slight predominance to the middle and southern parts. 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. Eels are imported from Severn in the UK through quarantine procedures for restocking of Swedish feral populations. A minor part of the Swedish aqua culture is farming of pike-perch and perch. Of the shell fish production, blue mussel has the highest tonnage, while oysters and crayfish are more limited. The main tonnage of fish is produced in the continental zone, while the Swedish west coast is the area for production of blue mussels for consumption. Many of the Swedish farms are quite small compared to the ones in other parts of Europe, but there is a trend towards bigger units. A large proportion of Swedish aquacul-

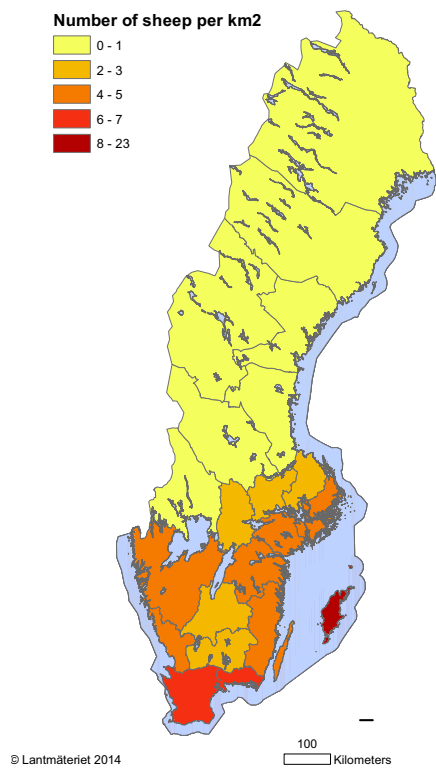
Map 1. Number of cattle per km² in 21 Swedish counties as of June 2013



Map 2. Number of pigs per km² in 21 Swedish counties as of June 2013



Map 3. Number of sheep per km² in 21 Swedish counties as of June 2013.



ture is owned by foreign companies, mainly Finnish. The interest in production of blue mussel for consumption has slightly stagnated during 2012, while interest remains high for the cultivation for the purpose improving environmental conditions. Swedish oysters are popular and in demand but it is difficult for the industry to maintain a high production. The health status in Swedish aquaculture is still high, serious diseases and outbreaks are rare.

TRADE IN LIVE ANIMALS

In 2013, 127 pigs were brought in to Sweden from Norway, 1,365 pigs from Finland of which 235 were for slaughter. 7 cattle came from Denmark, 3 sheep from Denmark and 334,000 day-old chicks from Great Britain, Germany, the Netherlands and France.

The number of animals leaving the country during 2013 were 226 cattle, 45 sheep, 5,519 pigs of

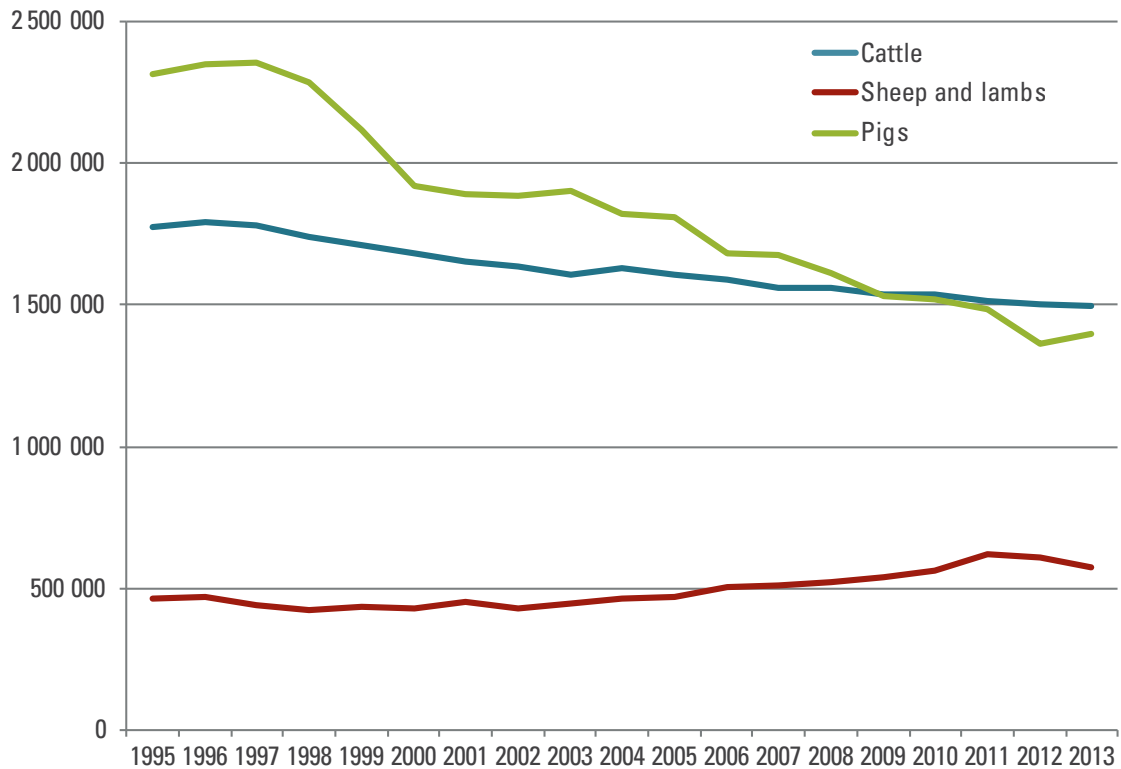
which 3,721 were sent for slaughter in Germany and 1,502 to Finland. Altogether 3,847,000 day-old chicks were sent to Denmark, Lithuania, Poland, Germany, Latvia and Finland.

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Figure 1. Number of Swedish livestock 1995-2013.



Animal databases

THE CENTRAL REGISTER OF HOLDINGS

The Swedish Board of Agriculture is responsible for the Central Register of Holdings. Each holding is allocated a unique identification number (holding number). The register contains information on 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 (for bovine animals, pigs, sheep and goats) 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 keeper 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 Dairy Sweden (Växa Sverige). The organisation is responsible for the database for dairy herds (Ko-databas). 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 programs 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.

RECORDS AT THE SWEDISH ANIMAL HEALTH SERVICE

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

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 individ-

ual 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.



Photo: Marianne Elvander/SVA

Institutions, organisations and laboratories involved in monitoring

SWEDISH BOARD OF AGRICULTURE

The Swedish Board of Agriculture (SBA) is the Government's expert authority in the field of agricultural and food policy, and is responsible for agriculture, aquaculture and horticulture. 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 agro-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 preventing spread of contagious animal diseases. The SBA is also the chief authority for the Swedish district veterinarians. Besides 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 government expert authority within the field of risk assessment, prevention, diagnostics and the control of contagious animal diseases and other serious infectious diseases including zoonotic agents.

Diagnostic capacity for the most important contagious animal diseases is available at SVA. Antimicrobial resistance in bacteria from animals and from food of animal origin is monitored regularly and several control- and monitoring programmes are conducted in cooperation with stakeholder organisations and relevant authorities. Research and development are also important tasks for SVA.

THE PUBLIC HEALTH AGENCY OF SWEDEN

The Public Health Agency of Sweden (former Swedish Institute for Infectious Disease Control) was established on January 1, 2014 and is a government agency accountable to the Government. The new authority will operate across the public health spectrum and integrate communicable disease control with other public health work and will work to identify and highlight public health issues where effective interventions can be made.

The authority will promote health and prevent diseases by supporting communicable disease control with epidemiological and microbiological analyses. The Public Health Agency of Sweden will also focus on preparedness for outbreaks of severe infectious diseases, both within the country and outside the borders. Diagnostic analyses of different bacteria, viruses, parasites and fungi, 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 that falls under the Ministry for Rural Affairs. 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 co-ordination of drinking water control. The work to promote fair practices in the food trade aims at ensuring that food products are in fact what it appears to be, so that consumers are not misled as to the food's composition, nutritional or product content, weight or volume, keeping qualities or production methods as well as how the food is presented in the shop.

COUNTY ADMINISTRATIVE BOARD

Sweden is divided into 21 counties, each of which has its own County Administration and County Governor. The County Administrative Board is a government authority that exists in close proximity to the people in each county. The County Administrative Board is an important link between the people and the municipal authorities on the one hand and the government, parliament and central author-



Photo: Rickard Wolrath/SVA

ities 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 organization 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.

SWEDISH ANIMAL HEALTH SERVICE

Swedish Animal Health Service, AB (SvDHSV) 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, SvDHSV 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 98% 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 health programmes, administered by SPMA such as control for *Salmonella*, *Campylobacter*, coccidiosis and clostridiosis.

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 organization 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 pullet 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.

SWEDISH FISH HEALTH CONTROL PROGRAMME

The main objectives of the Swedish Fish Health Control Programme are to prevent the occurrence of and to stop the spread of serious and contagious fish diseases to fish farms and to wild populations of fish. The services are open to all registered fish farmers. The Swedish Fish Health Control Programme is owned by the main fish farming companies in Sweden and is officially responsible for general animal health programmes for farmed fish. Important parts of the fish health control programme are a breeding programme for good fish health, participation in a control programme for virus and bacterial infections as well as a vaccination programme. In addition, information, advice and training services are offered to the associated fish farming companies. Since 1990 the Swedish Fish Health Control Programme has worked with a voluntary control programme aimed at national control and eradication of renibacteriosis.

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**Disease
Surveillance
2013**

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. The Swedish Animal Health Service administers a control programme which has been running 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 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

P. multocida, and thereby decrease the incidence of AR in all herds. Nucleus and multiplying herds are actively controlled for the presence of *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, but any time AR is suspected in any herd, it should be tested for presence of *P. multocida*. If *P. multocida* is detected, the health declaration is withdrawn and restrictions on the sale of pigs are employed until the herd is sanitised and declared free from the disease.

Diagnostic tools developed by DAKO (Copenhagen, Denmark) and evaluated at the National Veterinary Institute during the late '80s and early '90s 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 90s 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* 2005-2013. 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

Aujeszky's disease

BACKGROUND

Aujeszky's disease (AD) virus is a herpes virus with capacity to infect several species but the pig is the natural host. The disease is important in the 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, operated by the Swedish Animal Health Service that was introduced in 1991. The Swedish Animal Health Service 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, 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 prevalence of clinical signs and production results. The investigated farm is also placed under restrictions during the investigation.

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

Active surveillance

In 2013, all samples collected in the abattoir sampling part of the surveillance carried out by the Swedish Animal Health Service 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.

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

RESULTS

Passive surveillance

During 2013, two clinical suspicions of AD were investigated. In both herds, clinical signs from the central nervous system of newborn piglets were the main clinical manifestation. The herds were sampled for both AD and PRRSV. 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 declared negative for AD.

Approximately 1,500 samples from animals for export and from breeding centres were tested during 2013 and all were negative for antibodies to AD virus.

Active surveillance

In 2013, 1,548 samples corresponding to 516 herds sampled at slaughter were analysed within the active surveillance programme. All these samples were negative for antibodies to the 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 2007-2013.

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

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 more infected animals over a larger area, 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

In addition to clinical surveillance, serological testing for Bluetongue prior to import and export, and at breeding centres was performed.

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 2013 Bluetongue surveillance, 1,200 animals from 121 herds geographically spread over the country were selected for testing. The holdings were not randomly selected, but 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 2013 to mid March 2014 and samples were analysed

with the milk ELISA routinely used. The number of tested herds was sufficient to detect 2 % prevalence with 95% confidence.

RESULTS

Two clinically suspect cases were investigated and tested during 2013, and found negative. All other testing performed in 2013 was also negative.

DISCUSSION

In summary, no clinical suspicions of bluetongue were confirmed nor was there any indication of viral circulation during 2013.

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 and the EU situation appears favourable with circulation only in the endemic areas in southern Europe. 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 and again demonstrating that BTV may spread and take hold in livestock populations in Northern Europe. In 2013, one cow in Finland was found to be seropositive from this vaccine originating strain.

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Bovine spongiform encephalopathy

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. The current theory about the causative agent is the prion-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, strains of BSE which show diagnostic dissimilarities with classical BSE have been described. The possible spontaneous occurrence of these cases is being discussed, as well as possible links to classical BSE and potential zoonotic aspects.

Sweden has 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, recognized 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. 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, amended through SJVFS 2011:29 (and 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 from animals in passive surveillance and risk categories are analysed at the National Veterinary Institute. Samples from healthy slaughtered animals were analysed at a private laboratory in Sweden, until March 15, 2013. Sampling from healthy slaughtered cattle ceased March 15, 2013 due to changes in legislation. From March 16, 2013 all samples are analysed at the National Veterinary Institute.

Passive surveillance

All suspicions of BSE (bovine animals not respond-

ing 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 design is in accordance with Regulation (EC) No 999/2001 Annex III and Sweden applies derogation in accordance with Commission Decision 2008/908.

The following categories were sampled in the active surveillance until March 15, 2013:

- All healthy slaughtered cattle above 72 months of age.
- All healthy slaughtered cattle of none Swedish* origin above 30 months of age.
- All emergency slaughtered cattle above 48 months of age, including slaughter used for feed to large carnivores.
- All fallen stock (animals dead or killed on farm but not slaughtered for human consumption) above 48 months of age.

The following categories were sampled in the active surveillance from March 16, 2013:

- Cattle of Swedish* origin above 48 months of age that have remarks at antemortem inspection before slaughter or are emergency slaughtered.
- Cattle of other than Swedish* 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 Sweden*.
- 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 render-

ing 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.

The samples from fallen stock, emergency slaughter, and some samples from normal slaughter at small abattoirs were examined with Bio-Rad TeSeE SAP. In case of positive or inconclusive results the material was prepared and examined by Bio-Rad TeSeE Western Blot.

The large majority of the samples from healthy slaughtered animals i.e. samples taken before March 15, 2013 were examined with rapid tests at a private laboratory. The samples were tested with IDEXX HerdChek Bovine Spongiform Encephalopathy Antigen Test Kit (BSE EIA). In case of positive or inconclusive results the material was prepared and examined by Bio-Rad TeSeE Western Blot at the National Veterinary Institute.

RESULTS

Feed

In 2013, 132 feed samples were taken at feed mills. All of these samples were negative. No samples were collected at primary production at farm level during 2013.

Animals

Passive surveillance

In 2013, four cattle were examined due to clinical suspicion, all with negative results.

Active surveillance

In 2013, 20,177 samples were examined for BSE. All samples were negative. Of these samples 10,587 were from fallen stock, 37 samples were from animals with remarks at antemortem inspection before slaughter, 138 samples were from emergency slaughtered animals and 9,412 samples were from healthy slaughtered animals.

* Cattle that originates in Sweden or in a country included in the list in Commission Decision 2008/908.

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 5-10 years ago.

Reports of prion transmission studies including several passages in different species have shown that prion-strains do not always remain stable through these passages. The 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.

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Bovine viral diarrhoea

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 be 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.

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

A risk-based surveillance scheme was introduced in January 2010 when the country was divided in regions by BVD-status. In regions free from BVD, sampling is mainly directed towards herds buying or selling live animals. Herds are individually risk categorised based on the number of herds they have purchased from and sold to during the preceding 12 month period. In regions not free from BVD all herds are sampled annually by continuous data collection.

Surveillance of dairy herds is performed by sampling bulk milk in conjunction with milk quality testing. The laboratory gets an order from Växa Sverige (the former Swedish Dairy Association) about which herds to sample. All samples are marked using bar code labels, to preserve anonymity. 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%. Herds that are infected are screened, and persistently infected virus carriers are identified and removed. Other important parts of the programme are creating a positive attitude to biosecurity in the farming community and protecting the free herds from acquiring BVDV. Details on numbers of samples and herds tested 2013 are given in Tables 3-5.

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 analyzed by an in-house IPX (immunoperoxidase) or PCR tests.

RESULTS

Numbers of antibody positive bulk milk, slaughter, and field samples tested in 2013 are given in Table 3. As shown in Tables 4-5, a total of three herds were antibody positive in the surveillance area, and 11 herds in the eradication area during the year. All those herds were investigated and considered to be non-infected. In 2013, 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 2013. 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. That herd was later declared free from the dis-

ease. Thus, the results indicate that the programme objective to eradicate BVD has now been achieved. Continued surveillance is necessary to confirm freedom from the disease.

REFERENCES

Swedish Dairy Association, Statistics for 2013.

Table 3. Total numbers of samples with different contents of BVDV antibodies tested in 2013.

Sample type	Class/Finding	Eradication area	Surveillance area
Bulk milk	0-1*	2,345	3,942
Bulk milk	2-3*	1	0
Blood sample at slaughter	Negative	5,677	8,231
Blood sample at slaughter	Positive	14	2
Field sample	Negative	1,630	1,405
Field sample	Positive	254	6

* 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 the surveillance area in 2013

Herd level risk*	Herd numbers (N)	Surveillance area	
		Dairy	Beef
Low risk	N of herds	2,681	7,130
	N of herds tested	1,235	1,823
	N positive	0	1
Medium risk	N of herds	1,520	1,258
	N of herds tested	1,215	825
	N positive	1	0
High risk	N of herds	437	254
	N of herds tested	385	223
	N positive	0	1

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

Table 5. Dairy and beef herd results from testing of BVDV antibodies in bulk milk or blood samples in the eradication area in 2013

Herd numbers (N)	Eradication area	
	Dairy	Beef
N of herds	650	1,913
N of herds tested	635	1,402
N positive	3	8

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 the 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 unpasteurized 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. Not more than 10 human cases have been reported annually. Except for one laboratory infection, 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 generalized aches. Some patients recover spontaneously, while others develop persistent symptoms that typically wax and wane. Genito-

urinary 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 last amended by Decision 2005/764/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.

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.



Photo: Bengt Ekberg/SVA

Diagnostic tests for animals with clinical signs suggesting brucellosis, animals included in the passive post-mortem 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 odd 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.

Ongoing serological testing of all susceptible species prior to import and export, and in bulls and

boars at semen collection centres, adds to the passive disease surveillance of *Brucella* spp.

Brucellosis in dogs is not included in the Swedish Act of Epizootic diseases and the zoonotic potential of *Brucella canis* is considered to be significantly smaller than that of *Brucella abortus* or *Brucella melitensis*. Nevertheless, confirmed cases of infection with *Brucella 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 *Brucella canis* into Sweden. In 2011, an American Staffordshire terrier bitch imported to Sweden tested positive for *B. canis* using bacterial culture and serology. This dog was mated in Serbia and in Poland. In 2013, an outbreak of *B. canis* was detected in a kennel of Miniature Schnauzers. Three dogs out of 25 tested positive using bacterial culture and serology. One of the infected dogs was imported from Spain.

Humans

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

Active surveillance

Animals

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

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 *Brucella 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 thus was performed in 2013.

The bovine surveillance of 2013 was designed with a design prevalence (between herd) 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 *Brucella 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 2013 was designed with a design prevalence (between herd) 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 99% at the end of the year. To reach this

level of probability of freedom 3,760 samples over the year (4 samples per herd from 940 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 *Brucella suis* each year. Beginning 2009 and onwards serum samples will be tested every second year. This sampling was performed in 2013.

The pig surveillance of 2013 was designed with a design prevalence (between herd) 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.

RESULTS

Passive surveillance

Animals

During 2013 clinically suspect cases were reported from three bovine and two goat herds. Bulk milk, serum samples from affected individuals and samples from aborted fetuses were taken. All samples were negative. No clinical suspicion was seen in any other animal species.

All samples, serological and bacteriological, from active as well as passive surveillance were negative.

As mentioned above an outbreak of *B. canis* was detected in a kennel, with three dogs positive serologically or by bacterial culture.

Within the surveillance of aborted fetuses, 114 bovine, 89 ovine, 4 caprine, 4 alpacas, one bison, one gnu and 38 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 have 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 by a mother infected in Syria while she was pregnant. *Brucella* was isolated in blood from both mother and child. The child was

Table 6. Results of active surveillance during 2013, *B. abortus*, *B. melitensis*, *B. suis*.

	<i>Brucella</i> species	Calculated sample size	Number of samples	Number of holdings sampled	Number of positive samples
Cattle	<i>B. abortus</i>	4,300	4,295	4,295	0
Sheep/goat	<i>B. melitensis</i>	3,760	3,584	923	0
Pig	<i>B. suis</i>	750	303	303	0

healthy but was sampled since *Brucella* was detected in her mother. In 2013, 10 cases of *Brucella* were reported, 4 men and 6 women. One of these cases was reported as domestic. This case was a laboratory acquired infection where a student was infected in an educational setting while handling samples of *Brucella*. For the remaining cases in 2013, countries of infection were; Afghanistan (1 case), Iraq (3 cases), Iran (1 case), Somalia (1 case), Syria (1 case) and Turkey (2 cases).

Active surveillance

Animals

During 2013, 4,295 bovine serum samples from 4,295 individual holdings were analysed for *B. abortus*, 3,584 ovine and caprine serum samples from 923 individual holdings were analysed for *B. melitensis* and 303 pig serum samples from 303 individual holdings were analysed for *B. suis*, see Table 6. The number of samples tested for *B. suis* was considerably lower than planned. Taking into account the outcome of the surveillance the probability of freedom at the end of 2013 was 97% and the sensitivity of the surveillance 46%.

DISCUSSION

In summary, *Brucella* infection was not detected in cattle, sheep, goats or pigs during 2013. 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 foetuses from food-producing animals is an important part of the surveillance system.

An unknown number of stray dogs from countries where *Brucella canis* is endemic enter 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.

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 for the first time isolated from human diarrhoea in 1972 although spiral bacteria had been seen microscopically in human stool samples in earlier decades. 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 identifying the source of infection difficult. Risk factors for infection include consumption or handling of undercooked contaminated meat products (especially poultry), consuming contaminated unpasteurized milk and other dairy

products, drinking water from contaminated supplies, travelling abroad and contact with farm animals and pets.

The incidence of human campylobacteriosis has varied between 66.6 and 96.4 cases per 100,000 inhabitants (Figure 2). Of these, approximately 20-40% have been reported as domestic.

DISEASE

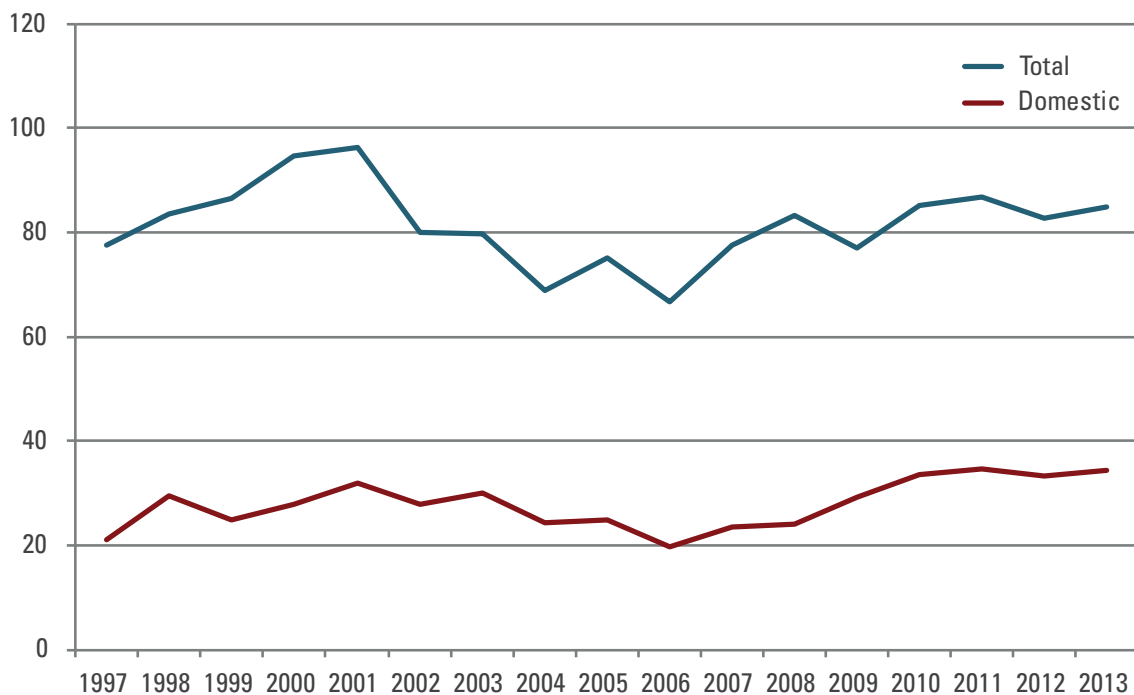
Animals

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 and a neurological disorder, Guillain-Barré syndrome.

Figure 2. Notified incidence (per 100,000 inhabitants) of human cases of campylobacteriosis in Sweden, 1997-2013



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. In the surveillance programme 2013, samples from turkey were included. Caecal samples from turkey were collected and analysed as pooled samples just as caecal samples from broilers. All samples were analysed according to ISO 10272:2006 parts 1.

Food

As part of the *Campylobacter* surveillance programme, neck skin and muscle samples were taken from turkeys at slaughter. Samples were analysed both quantitatively and qualitatively according to ISO 10272:2006 parts 1-2.

A survey on *Campylobacter* in fresh chicken breast fillet was undertaken at retail level. Samples were taken from Swedish and Danish chicken meat during August and September 2013.

Humans

Surveillance in humans is passive.

RESULTS**Animals**

In 2013, thermophilic *Campylobacter* spp. were detected in 267 (8.8%) of the 3,046 broiler flocks at



Photo: Bengt Ekberg/SVA

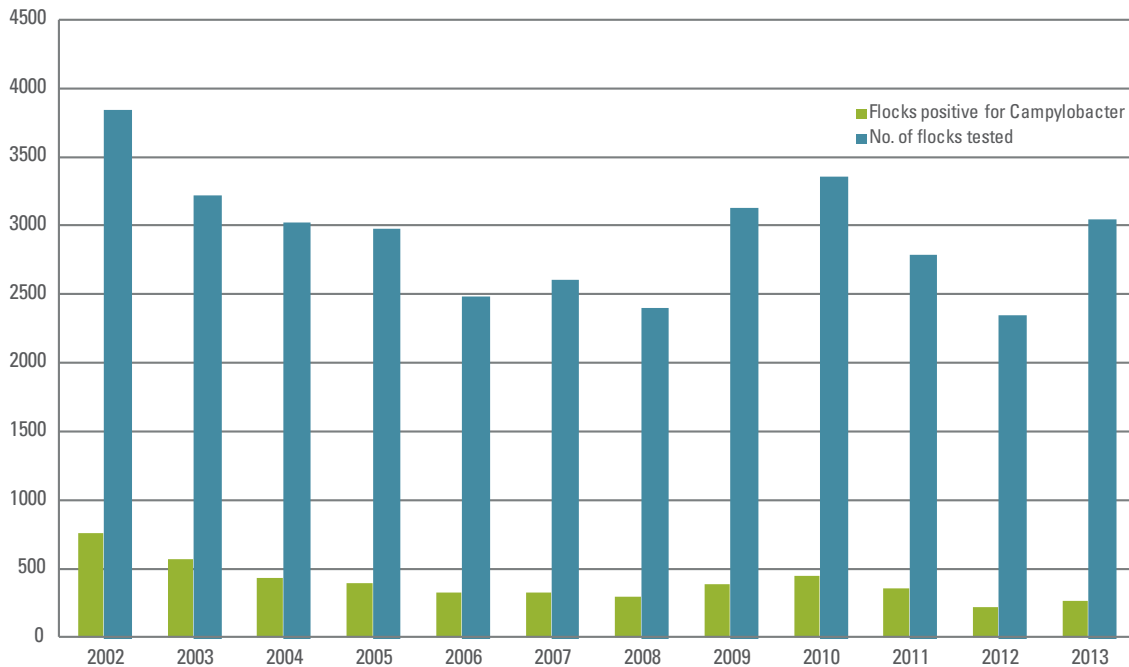
slaughter in the national *Campylobacter* programme (Figure 3). A seasonal variation of *Campylobacter* in broilers was observed with the least findings in winter and most in the summertime.

Campylobacter was detected in 40 of 105 turkey flocks (38.1%).

Food

In turkey neck skin, *Campylobacter* was detected after enrichment in 41 of 223 (18.5%) of samples; however, only three of 221 (2.2%) of samples had counts above 1 log cfu/g. In turkey muscle *Campylobacter* was detected after enrichment in seven of 210 (3.3%) of samples, but the quantification was demonstrated >1 log cfu/g in only 1.4% of the samples.

Campylobacter spp were detected in all (n=19) of the Danish broiler fillets and in all four samples of organic Swedish fillet and in 42% of the fillet (n=55) from Swedish large-scale slaughterhouses. In quantitative analysis, one sample each from organic and Swedish large-scale chicken had a level above 1 log cfu/g, whereas 9 of the Danish broiler fillet had counts above 1 log cfu/g.

Figure 3. Prevalence of *Campylobacter* in broiler flocks in 2002-2013.

Humans

In 2013, 8,114 cases of campylobacteriosis were notified. A majority of the reported cases were infected outside Sweden. Of the reported cases, 41% (3,305 cases) were domestic. The incidence in domestic cases (34.3/100,000 inhabitants) increased by 4% compared to the year before. The number of notified cases of campylobacteriosis usually increases during the late summer, and this also happened in 2013. However, in 2013 there was an unusual peak in September with more than 600 domestic cases as compared to approximately 400 domestic cases during the previous years. This peak might be explained by the warm weather, but there might also have been undetected outbreaks during this period. Two outbreaks of campylobacteriosis during 2013 were reported. However these two outbreaks were small and did not occur in September. Two outbreaks involving Swedes abroad were reported, but no source of infection in these outbreaks have been reported. In the first outbreak, 20 Swedes became ill at a tennis camp in Marbella in May and *Campylobacter* was verified in 7 of the cases. The second outbreak involving Swedes was at a wedding in France in October. Of the 120 guests from many different countries, 50 became ill.

DISCUSSION

During the last fifteen years, the number of reported human cases of campylobacteriosis has remained high. 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.

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 ever reported (Figure 3). Reasons for this decrease are not clear but might be related to better hygiene and/or unusual weather conditions in the summer 2013 which was extremely dry.

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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Classical swine fever

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 it is caused by an unrelated virus. 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. The most recent reported outbreak within the EU was in Latvia in late 2012. Classical swine fever virus (CSFV) is present in the wild boar population in some European countries. Some Eastern European countries have had difficulties in controlling CSFV in backyard and feral pigs although the situation has improved in recent years. CSFV is also present in Russia as well as in Asia and South America. CSF has not been diagnosed in Sweden since 1944.

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°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 neutralization (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 prevalence 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.

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

Active surveillance

Samples collected for the abattoir sampling part of the surveillance carried out by the Swedish Animal Health Service 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 with a design prevalence (between herd) 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 2280 samples over the year (2 samples per herd from 95 herds per month) were needed, based on structure of the pig production in 2012.

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

Four investigations following clinical suspicion of CSF were carried out during 2013. The clinical manifestations included reproductive failure, neurological signs and haemorrhages in piglets and circulatory disorders including haemorrhages in sows. Following further investigations, including sampling, the herds could be declared negative for CSF (all investigations also included testing for PRRS and/or african swine fever).

Within the surveillance of aborted foetuses, 46 foetuses from 19 herds were examined for the CSF viral genome and all samples were negative.

The approximately 1,050 samples originating from sampling for export and at breeding centres were all negative for CSFV.

Active surveillance

Serum samples from 1,032 pigs were analysed and in none of them antibodies to CSFV could be found. The number of samples tested for CSF was considerably lower than planned and taking into account the outcome of the surveillance, the probability of freedom at the end of 2013 was 98%.

DISCUSSION

The results from the passive and active surveillance for CSF in Sweden during 2012 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. These changes partly explain the difficulties in managing the active surveillance in terms of planning design and number of samples.

The present situation regarding CSF in the EU, with isolated outbreaks close to Sweden (most recently in Latvia 2012) and the extensive movement of products and people, including labour in the animal production sector, emphasizes the need for both passive and active surveillance for CSF.



Photo: Karin Bernodt/SVA

Coccidiosis and clostridiosis

BACKGROUND

Coccidiosis and clostridiosis are intestinal diseases that commonly affect broiler chickens around the world. 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 long-term goal is to replace anticoccidials by other preventive measures.

Field control of anticoccidial efficacy is performed by a lesion scoring method in broiler chick-

ens 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 2013, a lesion score (MTLS/Mean Total Lesion Score) of > 2.5 was exceeded in one flock (MTLS of 3.2) of 35 investigated broiler flocks. According to regulation in the health control programme for coccidiosis and clostridiosis in broilers an investigation has been launched in this farm with proposals to improve hygiene, and feed samples have been sent to laboratory for analysis.

Samples for histological examination of the liver were submitted from 15 broiler flocks with > 0.5% condemnation due to liver lesions. The samples were collected at the abattoir. Lesions consistent with clostridiosis (i.e. cholangiohepatitis) were observed in 14 out of the 15 flocks. In the 15th sample 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 long-term trends towards reduced anticoccidial efficacy or increased prevalence of coccidiosis and/or clostridiosis were observed.

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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.



Photo: Anders Lindström/SVA

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 in Sweden 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 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 with radius of 25 km in Södermanland County during 2011 and analysed in 2012 using a newly developed semi automated magnetic capture probe DNA extraction method and 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. By the end of 2012, preliminary results showed that one out of 661 analysed samples were positive. The positive sample originated from a previously known infected area (Västra Götaland).

From the three known infected areas, hunters were asked to submit 30 foxes from each area. Sampling was done during 2012 and continued in 2013. By December 2012, 10 foxes had been examined and one was positive.

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 be infected abroad.

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 characterized 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 localization 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 de-wormed 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 Sweden. 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). Before 2004 *Echinococcus* spp. was voluntarily reported by the laboratories.

SURVEILLANCE

Animals

As *E. multilocularis* does not cause clinical signs in the final host, the monitoring in these species is active.

The second national screening, initiated in 2012, continued in 2013. A network of local hunters, coordinated by the Swedish Association for Hunting and Wildlife Management was responsible for the sampling. In certain areas sampling was also done by the Swedish University of Agricultural Sciences. Taking into account the sensitivity of the test, a design prevalence of 0.1% and using a 95% confidence level to detect at least one positive fox and that all samples may not be suitable for analysis, the aim was to analyse 4,000 faecal samples from foxes. A stratified systematic sampling procedure was used where fewer samples were requested from the northern part of Sweden. Samples were analysed with the MC-PCR at the National Veterinary Institute. To determine, with a 95% confidence level, if 1% or more of samples originated from species other than foxes, approximately 300 randomly collected samples are being analysed by a species-specific qPCR demonstrating red fox DNA.

From the three known infected areas, hunters were asked to submit 30 foxes from each area. Sampling was initiated in 2012 and continued in 2013. The foxes are tested with SSCT.

All free-living wolves submitted to necropsy at the National Veterinary Institute are analysed with SSCT.

Within a EMIDA-funded research project initiated in 2012, (www.emiro.org) the Swedish University of Agricultural Sciences performed sampling of rodents and fox scats in 4 restricted areas (20 X 20 km), two areas in Södermanland and Västra Götaland County where *E. multilocularis* had previously been identified and in two areas where no cases of *E. multilocularis* has been found in Småland and Södermanlands County). 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 (i.e. in 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 Stieger et al. (2002). All positive samples were further confirmed by DNA sequencing and a BLAST search.

Humans

Surveillance in humans is passive.

RESULTS

Animals

The national screening initiated in 2012, continued during 2013 and a total of 1,537 fox scat samples were analysed and one positive fox scat was identified. This sample was also included in the EMIDA project (see below). The positive sample originated from a known infected area in Södermanland County. Results from the analysis of species are pending.

In the sampling of foxes from the three known infected areas, 63 foxes were analysed and two were positive, one from Södermanland and one from Västra Götaland County.

Within the EMIDA project a total of 438 rodents were trapped during 2013 and results are pending. A total of 129 fox scats were collected. Preliminary results showed that in the two areas in Småland and Södermanland County where no cases of *E. multilocularis* have been found, nine samples were collected and analysed and no positives were found. In the two known infected areas in Södermanland and Västra Götaland County, five out of 120 samples were positive. One of these positive samples was also included in the national screening.

During 2013, 13 foxes (four whole foxes and nine faecal samples) and faecal samples from six wolves (*Canis lupus*) and three dogs were tested with the MC-PCR. In addition intestines from 41 wolves were examined with the SSCT. All were negative. These samples were not included in any monitoring project.

Humans

In 2013, 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 how and when the parasite was introduced into the country. Increased surveillance using fox faeces will continue to clarify the distribution of the parasite and also any future change in prevalence. Surveillance in intermediate hosts will also continue to try to identify the intermediate host(s) involved in the life cycle of *E. multilocularis* in Sweden. Based on the studies that exist today, the risk that humans 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, localization and pressure exerted on surrounding organs or tissues. The incubation period for developing cystic echinococcosis ranges between several months to years.

LEGISLATION

Animals

Detection of the parasite is notifiable in all animals according to (SJVFS 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). 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 2013 lesions from 6 reindeer were tested at meat inspection and 41 wolves submitted to necropsy were tested with the SSCT. *E. granulosus* was not detected in any animals in 2013.

Humans

In 2103, 17 cases of cystic echinococcosis were reported, which is a decrease from the peak in 2010 (when 30 cases were reported). In 2013, the reported cases ranged from 17 to 80 years of age (median 41 years), 10 were women and 7 were men. They were all considered to have been infected abroad in areas where the parasite is endemic and the most frequently specified country of infection was Iraq (6 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.

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 after an incubation period of 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 onwards, 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 2013 are given in Table 7.

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 2013.

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.

REFERENCES

Swedish Dairy Association, Statistics for 2013.

Table 7. Total numbers of herds and animals tested for EBL antibodies in 2013.

Herd type (sample type)	Herds	Animals
Dairy herds (1 bulk milk sample per herd)	1,798	-
Beef herds (blood from 1-3 animals per herd)	3,132	6,746
Beef herds with at least three animals tested	1,172	-
Beef herds with two tested animals	787	-
Beef herds with one tested animal	1,173	-

Footrot

BACKGROUND

Footrot is a globally distributed contagious disease in sheep and goats. The causative agents are *Dichelobacter nodosus* (*D. nodosus*), in conjunction with *Fusobacterium necrophorum*. Predisposing factors are humid and warm weather conditions, and inter-digital dermatitis is a precursor to footrot. The severity of footrot depends on the strain of *D. nodosus* and the environmental conditions.

The first case of footrot in Swedish sheep was diagnosed in 2004. Data from all affected flocks have been recorded since 2004. A prevalence study on slaughter lambs was performed in 2009. A voluntary control programme for footrot (“Klövkontrollen”) was launched by the Swedish Animal Health Service in 2009.

DISEASE

The clinical signs are typical foot lesions, and lameness due to the painful lesions. Lameness is not a consistent clinical sign in all affected sheep. Footrot

may vary in severity from inflammation of the inter-digital skin to complete underrunning of hoof horn.

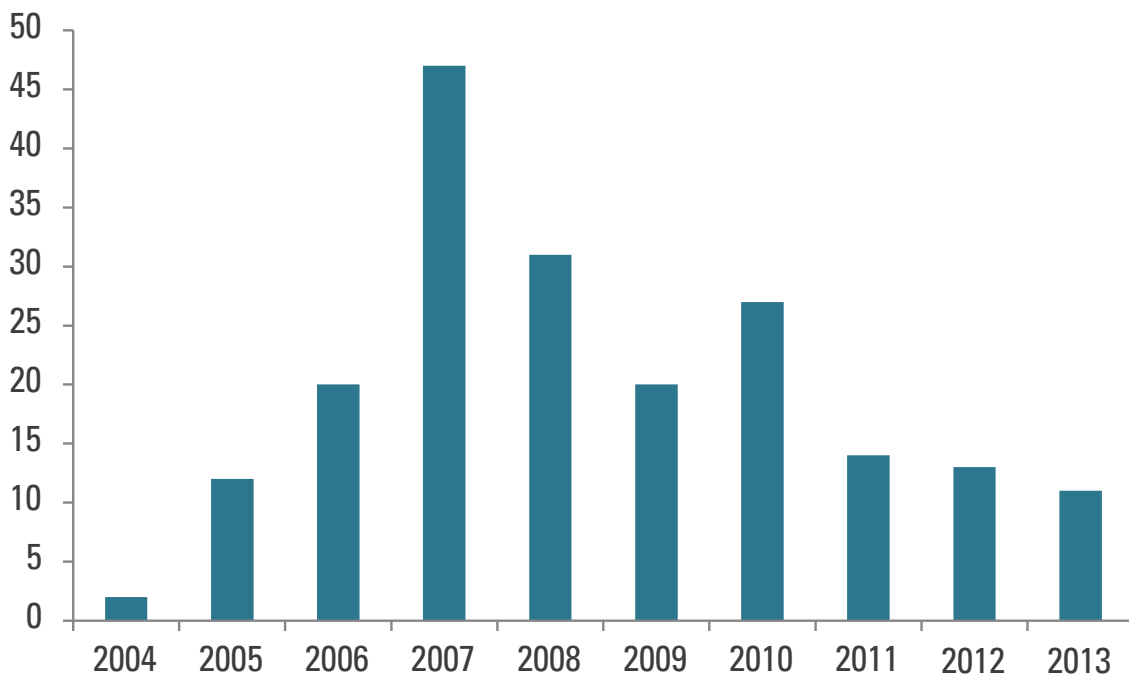
LEGISLATION

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. Feet are inspected by veterinarians and sheep farmers on an annual basis. The inspections are performed during August 15 to October 15, when the risk for 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 noted the following measures are taken: foot bathing, moving to clean pastures and culling of

Figure 4. Number of sheep flocks detected with footrot 2004-2013



Data from Ulrika König, Fårhälsövården

chronically infected sheep. Flocks with a history of footrot can be certified ten months after no signs of the 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.

RESULTS

During 2013, 11 flocks were detected with footrot, compared to 47 flocks during 2007 (Figure 4). In the programme, measures were taken in 9 flocks and 238 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 key 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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Photo: SVA

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™ IBR-ab, SvanovaR). 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 ani-

mal 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 the 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, 3,274 bulk milk samples and 6,960 serum samples from beef cattle were examined. 591 cattle were tested at semen collection centres and 50 cattle were tested prior to export. In addition, 2 European bison, 11 moose and 3 reindeer were tested. All samples were tested negative.

Within the clinical passive surveillance, 3 bovine herds were investigated by serology and/or PCR, due to clinical suspicions of IBR. Diagnostic testing ruled out the suspicions.

DISCUSSION

In summary no herd or individual animal was diagnosed with IBR infection during 2013. This supports Sweden's IBR free status.

Influenza

BACKGROUND

Influenza 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 mutations (“antigenic drift”) and through mixing of existing strains (“reassortment”). Influenza viruses are classified into subtypes based on the surface antigens: hemagglutinin (H) and neuraminidase (N).

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

Avian Influenza

BACKGROUND

Avian influenza (AI) is caused by Influenza A viruses. The viruses belong to different antigenic subtypes based on the hemagglutinin (H1-H16) and neuraminidase (N1-N9) surface structures. The disease is highly contagious and is spread both directly and indirectly. Wild birds are reservoirs for low pathogenic viruses (LPAIV), which may mutate and become highly pathogenic (HPAIV) if introduced into poultry flocks. 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.

During 2013, there were no outbreaks of HPAI or LPAI in Sweden. In the European Union (EU) six outbreaks of HPAI were reported, all in Italy. For LPAI, 27 outbreaks in poultry were reported; Germany (10), Italy (9), Netherlands (6) Spain (1) and Denmark (1). In the cases where subtyping was available, H7N7 was the most common type (n=4), H5N3 was identified in three outbreaks and H7N1 was found in two cases. The remaining ones were identified as H5 (8) and H7 (2) or with no subtype given.

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. In some cases, the only sign is sudden death of a large numbers of birds.

Humans

Since 2003 more than 600 human cases of H5N1 infection have been identified worldwide with a death rate of 60%. 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. 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 2013 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 animal health and serves as an early warning system for avian influenza in domestic poultry flocks.

Poultry

In 2013, sampling was performed in game birds (mallard ducks and pheasants), layers, turkeys, breeders, geese, ducks, ratites and small-scale broiler production. Ten blood samples from each holding were collected except for holdings with geese, ducks and mallard ducks 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 2,110 samples were taken. Table 8 gives an overview of all poultry flocks sampled in 2006 to 2013. 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 performed.

The surveillance programme for 2013 was based on representative sampling and the serological analyses were performed at the National Veteri-

Table 8. Number of flocks of different poultry categories sampled in 2006-2013.

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

¹ Between 2006 and 2010 sampling of all laying hens were reported under the same category regardless of housing system. From 2011 free-range (organic) laying hens are reported separately while the category 'laying hens' includes hens in furnished cages and indoor litter-based housing systems.

² Small-scale production.

nary Institute. All poultry were sampled at slaughter except for 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 guidelines.

Wild birds

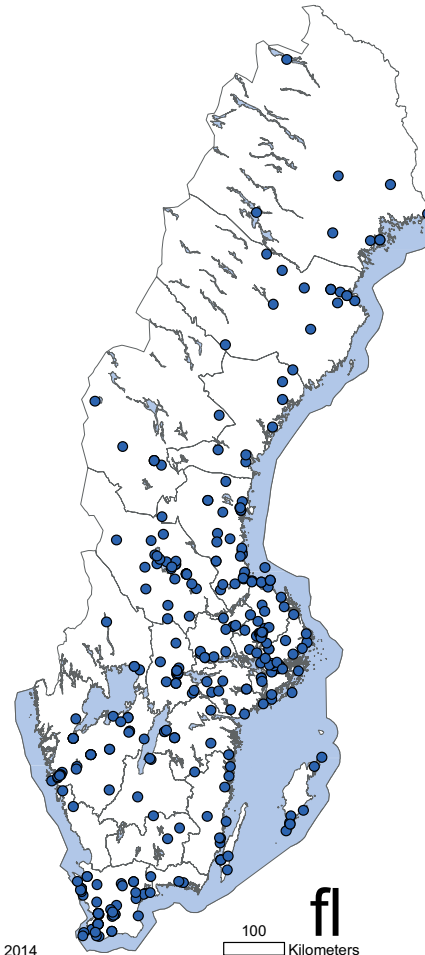
The surveillance in wild birds is passive and based on birds found dead or diseased and submitted for post mortem examination. The distribution of birds examined for avian influenza is shown in Map 4. Swab samples (both cloacal and tracheal) taken from these birds were analysed for the detection of avian 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/H1N1pdm09 and A/H3N2. Influenza A/H3N2 positive samples from patients below 15 years are further analysed for A/H3N2v. A/H3N2v derives from pigs and has caused outbreaks among humans in USA during 2011-2013. If influenza A positive samples could not be subtyped further characterization is performed to rule out zoonotic influenza A. Further 200-300 of the influenza positive samples from the diagnostics laboratory are subtyped/characterized. The former Swedish Institute for Communicable Disease Control, now Public Health Agency of Sweden, also performs a specific PCR for A/H5N1 and A/H7N9 if requested.

Map 4. Geographical location of wild birds analysed for avian influenza.



RESULTS**Poultry**

From the surveillance, no antibodies to avian influenza virus subtype H5 and H7 were detected in any of the sampled holdings.

In 2013, 12 clinical suspicions were raised based on clinical signs, post mortem examinations, production losses and/or egg shell abnormalities. Two of the suspicions were in hobby flocks and ten in commercial holdings. All clinical suspicions were negative for influenza.

Wild birds

Within the passive surveillance programme, 329 wild birds of 66 different species were sampled of which 154 was predator birds and 46 waterfowl or shorebirds. Three young mallards (wild) were found dead in a wetland area and on investigation LPAI of subtype H5 was found. Further genome analysis of the virus revealed similarities with a Eurasian gene pool, seen in wild birds in eastern Europe. All other birds were negative for Influenza A virus.

Humans

Influenza A subtype H5N1, H7N9 or H3N2v 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 dependant susceptibility. Wild birds, especially water fowl, 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.

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, but once introduced to poultry the virus is more likely to further spread between poultry flocks by routes 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 has most commonly been found within the passive surveillance programmes. In contrast, the low pathogenic strains have been detected within active surveillance programmes. Therefore, since 2011, the European Commission will no longer economically support 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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OIE – WAHID database.

Swine influenza

BACKGROUND

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 swine 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 naive 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 illness.

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. The influenza A(H1N1)pdm09 that previously had been demonstrated in pigs from most countries in Europe was for the first time demonstrated in Swedish pigs in 2013. Influenza A(H1N1) pdm09 was diagnosed in total in three herds, but as in other countries the clinical signs of disease were minor.

There has not been a regular monitoring for 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 annually been sampled with special focus on influenza, whereof influenza virus has been demonstrated in 3-5 herds per year (see below).

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 sub-clinical 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. An exception is the pandemic in 2009, caused by influenza A(H1N1)pdm09. The transmission of the influenza A(H1N1)pdm09 virus to pigs in the USA was followed by reassortment with endemic SIV. This resulted in reassortant viruses that include the novel influenza A(H3N2)v genotypes. The swine-origin A(H3N2)v strain includes the M (matrix) gene from the A(H1N1) pdm09 virus. Since August 2011, twelve human cases of swine-origin influenza A(H3N2)v (triple reassortant) were diagnosed in the USA (in five states). For 6 of the cases, no exposure to pigs was reported. In these cases, human-to-human transmission was suspected. Eleven of the cases occurred in children under 10 years of age. Swine influenza virus H3N2 with triple reassortant internal genes has been enzootic in USA since 1998.

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 notifiable.

SURVEILLANCE

Animals

Passive surveillance

During 2009 to 2013, 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



Photo: SVA

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 PRRS control programme and included a maximum of 4 sera per herd and sampling occasion. These sera were monitored 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).

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/H1N1pdm09 and A/

H3N2. Influenza A/H3N2 positive samples from patients below 15 years are further analysed for A/H3N2v. A/H3N2v derives from pigs and has caused outbreaks among humans in USA during 2011-2013. If influenza A positive samples could not be subtyped further characterization is performed to rule out zoonotic influenza A. Further 200-300 of the influenza positive samples from the diagnostics laboratory are subtyped/characterized. The former Swedish Institute for Communicable Disease Control, now Public Health Agency of Sweden, also performs a specific PCR for A/H5N1 and A/H7N9 if requested

RESULTS

Animals

Passive surveillance

Samples from 46 herds with respiratory signs were analysed for swine influenza virus from 2009 to 2012. In nine of these herds influenza A virus was detected, but in no case was the pandemic influenza A (H1N1)pdm09 virus found. In 1013, eight herds with acute respiratory signs were analysed. Influenza A was demonstrated in five of these herds and the pandemic A(H1N1)pdm09 virus was demonstrated in three herds.

Table 9. Reactors from the serosurveys performed 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%

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 9). 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.

Humans

Since its appearance in 2009, the influenza A(H1N1) pdm09 strain has become a seasonal influenza. The season 2011–2012 was, however, dominated by influenza A(H3N2) and only 145 laboratory-confirmed cases of influenza A(H1N1)pdm09 were diagnosed in Sweden. Of these, 42 were reported as hospitalized, with 5 needing intensive care. No deaths were reported. In 2013, influenza A subtype H5N1, H7N9 or H3N2v have not been identified in any human sample 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 9) in the testing protocol. The new pandemic influenza A(H1N1)pdm09 was in 2013 for the first time diagnosed in pigs in Sweden.

Influenza viruses are unpredictable and changes (mutations or reassortment) might be induced. This could enable the virus to be more transmissible among humans. Monitoring of human infections caused by these viruses is critically important to assess their pandemic potential.

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Leptospirosis

BACKGROUND

Several species of the spirochetal bacteria of *Leptospira* can cause leptospirosis and all mammals. Humans, are susceptible to several *Leptospira* serovars. Leptospirosis occurs worldwide but 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* 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 signs with affection of 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 and evenly distributed throughout the sampling period. See chapter on BVDV for details on sampling and population. The surveillance was designed with a design prevalence (between herd) of 0.2%, a within herd prevalence of 40% and a risk of introduction of 1 in 50 years. Sample size is calculated to reach a probability of freedom of 99% at the end of the year.

To reach this level of probability of freedom 1,800 samples over the year (1 sample per herd, 1,350 serum samples and 450 bulk milk samples) was needed.

In domestic pigs, the active surveillance is based on samples collected for the abattoir sampling part of the surveillance carried out by the Swedish Animal Health Service 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 with a design prevalence (between herd) of 0.5%, a within herd prevalence of 40% and a risk of introduction of 1 in 25 years. Sample size is calculated to reach a probability of freedom of 99% at the end of the year.

To reach this level of probability of freedom 405 samples (1 sample from 405 herds) over the year was needed.

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 detected 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 2013, 16 cases of *Leptospira* infection were reported in dogs and one in a horse. Also 75 cattle and one pig tested for export and in breeding centres, were negative regarding *L. Hardjo*.

In the active surveillance in cattle, 1,337 serum samples and 450 bulk milk samples were tested. One bulk milk sample was positive for antibodies to *L. Hardjo* and the investigation of this herd is ongoing. All serum samples were negative for *L. Hardjo* antibodies, but five samples were positive for antibodies to *L. Sejroe*. Since the number of tested samples was similar to the planned number of samples, the goal of the surveillance was met.

All 211 samples tested in the active surveillance of *L. Pomona* in domestic pigs were serologically negative. The number of samples tested for antibodies to *L. Pomona* was considerably lower than planned. Taking into account the outcome of the surveillance, the probability of freedom at the end of 2013 was 98% and the sensitivity of the surveillance was 82%.

Humans

In 2013, five cases of leptospirosis were reported. One of these cases was reported as domestic. The remaining cases during 2013 were considered infected in Asia; two cases in Thailand and two cases in Malaysia. The cases infected outside Sweden have often acquired their infections during leisure activities in contact with water.

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*, and an even lower prevalence to the indigenous strain Mouse 2A in cattle has been recorded.

Because the surveillance of *L. Hardjo* and *L. Pomona* that has been in place since 1994 without positive findings, suggests that these serovars are not present in the Swedish cattle or the commercial pig population. 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 the only zoonotic species, *Listeria monocytogenes* was first described in 1926. Previously, sporadic cases of listeriosis were reported, often in employees in contact with diseased animals but since the 1980's 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 marinated vacuum-packaged fishery products, meat products and soft cheeses or other ready-to-eat foods with long shelf-life. The infection can also be transmitted from infected animals to humans or via person-to-person contact. The environment and animals serve as important reservoirs of the pathogen.

L. monocytogenes is destroyed by heating (pasteurization and cooking). The bacterium is able to grow 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 40-90 human cases have been reported annually. Outbreaks have been associated with vacuum-packaged fish (1995-1996) and with cheese made of unpasteurized goat milk (2001). During later years, an increasing trend for cases of listeriosis has been noted both in Sweden and internationally. In 2013, the highest number of cases ever was reported (93 cases). This followed a period of decrease in 2010 and 2011 and increasing number of cases again in 2012.

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 septicaemia.

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, the average being about 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 2013:634).

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 completed during 2015.

Humans

The surveillance in humans is passive. Isolates from human cases are sent to the Public Health Agency of Sweden for typing using the methods suggested by the *Listeria* reference laboratory in Paris.

RESULTS

Animals

In 2013, listeriosis was reported in 45 sheep, four cattle, two hens, one goat, one farmed deer and in one camel.

Food

Available results from official sampling by local authorities at food enterprises showed that 484 samples from various food products were analysed qualitatively. *L. monocytogenes* was detected in 15 of these samples.

No national survey was performed on *L. monocytogenes* in food during 2013.

Humans

In 2013, 93 cases of listeriosis were reported (incidence 0.96 cases per 100,000 inhabitants). This is the highest number ever reported and an increase with almost 30% from the year before (72 cases). A trend analysis for the years 1983-2013 shows that the incidence of listeriosis has increased with 2.5 % per year (Figure 5). A majority of the cases reported in 2013 were elderly people over 70 years. The age groups above 80 years were the most common

with 39% of the cases. No pregnant women and/or infants were reported with listeriosis in 2013. Of the reported cases 50% were men. The counties Västernorrland (incidence 2.9), Gävleborg (2.2), Gotland (1.7), Jämtland (1.6) and Skåne (1.2) had the highest incidences in 2013. On a ten years average (2004-2013), 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 2013, 82 cases were reported with Sweden as country of infection. Five cases were reported as infected abroad and six cases had missing information about country of infection.

In 2013, the majority (97%) of the human isolates was sent in to the Public Health Institute for typing. The most common molecular serotypes were IIa (71 %), IVb (17 %), IIb (6 %) and IIc (2 %).

In 2013, a large outbreak continuing in 2014 was reported. From October 2013 more cases of listeriosis than expected were notified to the Public Health Agency. Investigation showed that until April 2014, 32 cases shared the same serotype, IIa, with identical Pulsed Field Gel Electrophoresis (PFGE) patterns and that cold cut meat was the suspected source of infection. During the outbreak, several Swedish food producers recalled their products due to positive sampling for *Listeria*. Isolates with the same PFGE pattern were identified in several products of cold cut meat from one of these food producers. The production line was closed.

DISCUSSION

An increasing trend of reported human cases of listeriosis has been observed in Sweden and in several other European countries. This trend has led to investigations and baseline studies across Europe. The reasons for the increase remain unclear but are most likely related to a combination of factors such as an aging population, the widespread use of immunosuppressive medications and consumer preference changes to more ready-to-eat foods. The decreasing Swedish incidence of listeriosis in 2010 and 2011 shifted in 2012 and the highest incidence ever was reported in 2013.

The case-fatality rate of listeriosis is high. Approximately one third of the patients die within three months but since most of them suffer from severe underlying diseases the impact of listeriosis is difficult to estimate. The microbiological criteria on *L. monocytogenes*, set in 2005, determine the stand-

ard the industry has to achieve for their products to be considered safe for consumers. The results from the 2010 survey, results described in the surveillance report for 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. Due to the successful nationwide project in 2010 where almost all isolates were typed, a similar collection of human isolates will be performed every third year. This collection was performed in 2013 and almost all isolates were sent in for typing. Surveillance of *L. monocytogenes* in humans and in food and food processing environment will be essential for understanding the sources for human infection and giving tools how to prevent infections. With a common goal to reduce the incidence of listeriosis a national five year strategy plan for listeriosis was published in 2013 as part of a collaborative project on prioritized zoonoses between the Swedish Board of Agriculture, National Food Agency, former Swedish Institute for Communicable Disease Control (currently the Public Health Agency of Sweden), the National Board of Health and Welfare and the National Veterinary Institute.

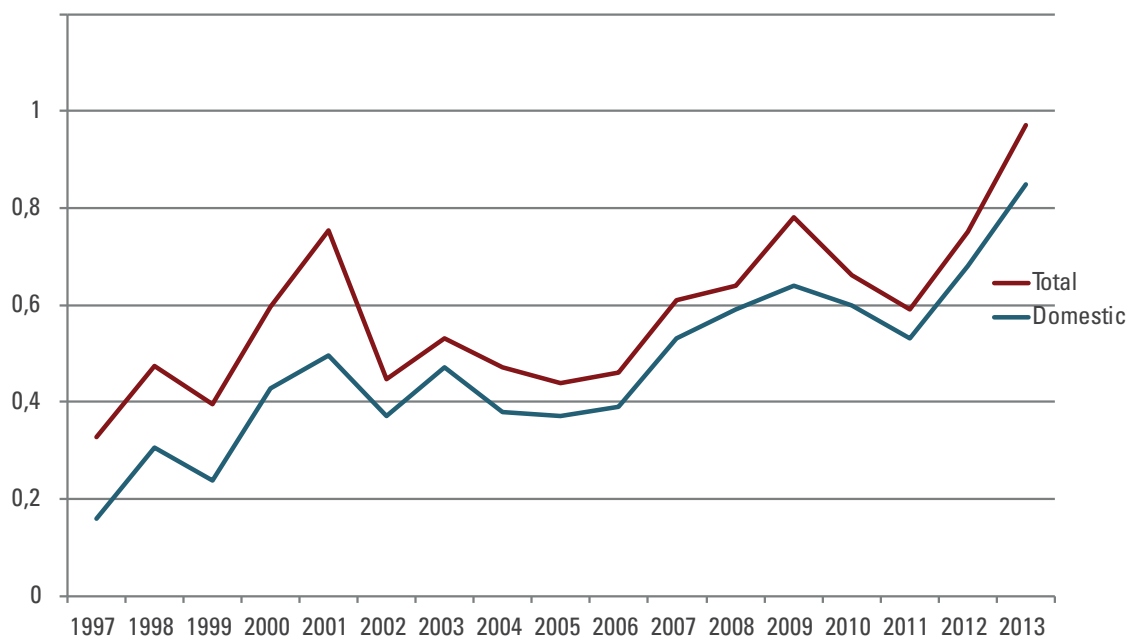
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Figure 5. Notified incidence (per 100,000 inhabitants) of human cases of listeriosis in Sweden 1997-2013.



Maedi-visna

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 the Swedish Animal Health Service in 1993 and an additional simplified version with single sampling of sheep and goats to identify and enroll 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. 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 a farmer's contract and a flock specific M-status gained by repeated blood sampling and testing. The contract is signed by the farmer with an agreement that all sheep in the flock are individually identified and kept in record. Purchase of sheep is only allowed from flocks with the same MV status or higher.

Serology testing is performed on all sheep older than one year in the flocks. Negative serology grants the flock M1-status. A second sampling performed 12-16 months later grants M2-status if all samples are negative for MV antibodies. This procedure is repeated 12-16 months later and a negative result grants M3-status, which means that the flock is declared free from MV. The MV free status is maintained by retesting with intervals of 3-5 years. In flocks where antibodies are detected, depending on the prevalence of positive sheep, either a whole herd cull or eradication measures including selective slaughter is performed.

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 AHVLA. 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. Samples collected in the MV-programme are also used for other surveys (Brucellosis and Tuberculosis).

RESULTS

During 2013, 23,986 samples from 804 sheep flocks were analysed in the MV control programme for antibodies against MV virus of which six samples were considered positive.

At the end of 2013, 1,064 flocks with 47,475 sheep were declared free from MV corresponding to about 17% of the Swedish sheep population.

Approximately 600 samples were analysed within the simplified programme, all with negative results.



Photo: Bengt Ekberg, SVA

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 the Swedish Animal Health Service and the National Veterinary Institute. In 2014, the programme will be 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

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 beddings for two weeks. Transmission to humans often occurs in an aerosolized form. Humans may be exposed to virus aerosols during occupational or recreational activities, such as working with hay, cleaning barns or summer cottages, cutting wood and entering buildings contaminated with rodent excretions.

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 inter-annual variation coupled to the 3-4 year population cycle of the bank vole. During the seasons 2006-2007 and 2007-2008 the annual number of notified cases rose to 1,400.

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 2013, 119 cases of NE were reported, which was more than a twofold increase compared to the numbers reported in 2012 (Figure 6). Most reported cases were in the age category between 50 and 69 years and the median age was 59.5 years. No children below the age of 5 years old were reported. The reason for the difference between age groups is not completely understood, but most likely behavior is an important factor.

Almost all cases acquired their infection in Sweden. One case reported having been infected in Finland, where NE is common.

Like in previous years, a majority of the cases (93%) were reported from the five northernmost counties in Sweden. The incidences in the counties of Västerbotten and Västernorrland were approximately 15 cases per 100,000 inhabitants. For counties Norrbotten, Jämtland and Gävleborg, the incidences varied between 4 and 7 cases per 100,000 inhabitants.

In comparison to 2012 when more than half of the cases were reported in January and February, the majority (61%) of cases during 2013 were reported in November and December.

DISCUSSION

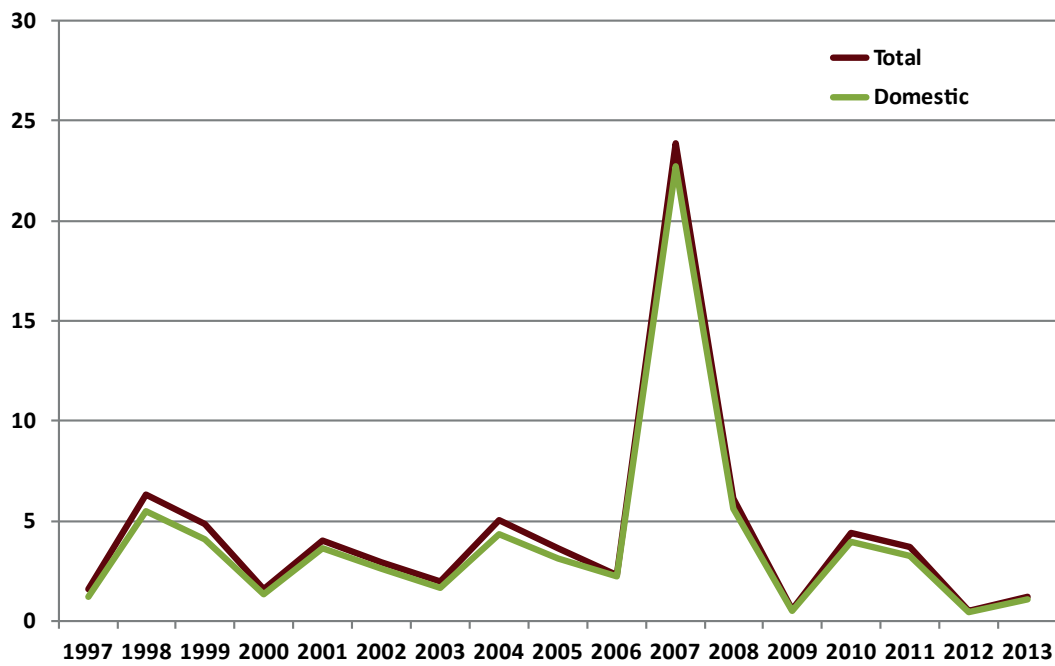
During the last years, fluctuations in the bank vole population have coincided with increases and decreases in the number of human cases of Puumala virus infections. The 3-4 year natural population cycle and variations in the climatic condi-

tions impact the rodent populations. In 2013, the number of cases was doubled compared to 2012, but the number has not yet reached the peak years 2006-2008.

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Figure 6. Notified incidence (per 100,000 inhabitants) of human Nephropathia epidemica in Sweden 1997-2013.



Paratuberculosis

BACKGROUND

Paratuberculosis is a common disease in most parts of the world. Sweden has a unique situation, where the prevalence is extremely low, perhaps 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 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 surveillances

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

Annual screening of 200 dairy herds in the years of 2000, 2003 and 2005.

Since 2004 sampling of all ruminants, above one year of age submitted for necropsy, for *Mycobacterium avium* subsp. *paratuberculosis* (MAP) by culture. This includes exotic ruminants like buffalo and camelids.

Screening of sheep herds during the years 1993-2011, first with serology, then with faecal culture. In 2007-2009 screening of beef herds with importation of animals during 1990-2005 with faecal culture.

In 2012 screening of beef herds with importation of animals during 2005-2011 with faecal culture.

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 samples were analysed by faecal PCR.

DISEASE

Paratuberculosis, also called Johne's disease, is an intestinal infection in ruminants caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP). *Mycobacterium* 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 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 based 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

In 2013 all samples from surveillance were cultured, except the faecal samples from the clinical awareness campaign which were analysed by PCR. The cultures were pre-treated with HPC and double incubation. Samples were then 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 within the surveillance programme that had mould overgrowth in the culture.

Samples collected because of clinical suspicion during 2013 were analysed with both direct PCR and culture. 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 exhib-

Table 10. 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	55	4
Sampled at post mortem examinations	218	153*

*No. of farms where PPN was noted; nine sheep had no such notion.

Table 11. Screening of cattle and exotic ruminants.

Surveillance in cattle and exotics	No. of samples	No. of herds
Beef herd surveillance programme	882	29
Sampled cattle at post mortem examinations	256	212
Sampled exotic ruminants at post mortem examinations	12	10

iting 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 include 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.

In 2013, ten cattle, and one sheep were analysed due to clinical suspicion of MAP.

Active surveillance

Surveillance programme in beef cattle

In the surveillance programme, the target population is beef herds that sell animals for breeding. The surveillance programme is managed by the Swedish Animal Health Service and financed by the Swedish Board of Agriculture. In total, the surveillance programme for bovine paratuberculosis encompassed 448 herds at the end of 2013 including all main breeding beef herds and a smaller number of dairy herds. In 2013, 29 herds were sampled within the surveillance programme with 882 samples from cattle and 55 samples from sheep.

The programme underwent some changes in 2011. In affiliated herds, 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. After three years of negative 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.

Clinical awareness campaign

The clinical awareness campaign from 2012-2013 resulted in a total of 271 faecal samples from 261 farms. One older cow initially tested positive on PCR. That animal was euthanized and necropsied with no signs of paratuberculosis. A substantial number of samples were taken from the intestine, faeces and lymph nodes – all negative on PCR and culture - concluding the first sample a false positive for MAP. All other samples in the campaign were negative on PCR.

Post mortem examinations

Sampling was performed on ruminants above one year of age submitted to post mortem examinations. Samples were taken from the ileal wall, ileal contents and ileocaecal lymph nodes and submitted to the National Veterinary Institute. In 2013, 497 animals were sampled; 256 cattle, 218 sheep, 9 goats, 2 fallow deer, and 12 exotic ruminants (6 alpacas, 3 bison, 1 yak and 2 camels)

RESULTS

No cases of MAP were detected in any of the examinations carried out in 2013 (Tables 10 and 11).

DISCUSSION

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

The screening of beef herds with cattle imported from 1990-2005 and 2006-2011 was aiming for the highest risk group of animals for MAP in Sweden; MAP has been detected in no other breeds or spe-

cies than beef cattle and all cases have been traced back to imported animals with the latest case back in 2005. A previous screening of older cows at abattoirs in 2009-2010, was also aiming at a risk group including cows older than six years with signs of weight loss, and resulted in 1,211 sampled cows.

The ongoing clinical awareness campaign targeted another risk-group of animals expressing weight loss with or without diarrhoea. The study finished in 2013 and the results are presented above.

Fallen stock is also 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. In addition to the present sampling, all herds affiliated with the control programme will have to send fallen stock for post mortem examination. The post mortem sampling also includes other susceptible species, like exotic ruminants, which are often kept in herds with animals imported from countries where MAP is common.

In a recent study, 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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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, the Swedish Animal Health Service launched a surveillance programme for PRRSV in which the Animal Health Service 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 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) meaning that any suspicion of PRRS is compulsory notifiable and notification will lead to investigation.

SURVEILLANCE

The purpose of the surveillance is to document freedom from 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 (HerdChek® PRRS X3 Antibody ELISA, Idexx Laboratories) is used and presence of the viral genome is analysed using a polymerase chain reaction (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 inves-

Table 12. Number of samples and herds tested in the active PRRS surveillance 2008-2013 in relation to the number of registered swine herds

	Field sampling		Abattoir sampling		Total number of samples	Number of registered swine herds in Sweden*
	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

* Source: Yearbook of agricultural statistics 2009-2013

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

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 with a design prevalence (between herd) of 0,5%, a within herd prevalence of 40% and a risk of introduction of 1 in 5 years. Sample size is calculated on a monthly basis to reach a probability of freedom of 97% at the end of the year. To reach this level of confidence 5,600 samples,

1,300 from field sampling and 4,300 from sampling at slaughter was needed (based on structure of the pig production in 2012).

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

Nine investigations following clinical suspicion of PRRS were undertaken during 2013. In the majority of these herds, reproductive failure was the main clinical manifestation and in four of the suspicions, 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, 46 fetuses from 19 herds were examined for the PRRSV genome and all samples were negative. Approximately 1,350 samples from animals for export and from breeding centres were tested during 2013 and all were negative for antibodies to PRRSV.

Active surveillance

In 2013, 1,024 samples, from 64 nucleus herds, multiplying herds and sow pools and 1,548 samples

from 516 herds sampled at slaughter were analysed. 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 12.

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 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 are 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 partly explain the difficulties in managing the active surveillance in terms of planning design and numbers of samples. However, the 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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Psittacosis

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 1930's. 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 generalized 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. The incubation period is usually between 5 and 14 days.

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 2013, *C. psittaci* was detected from two pigeons, from the counties of Skåne och Västra Götaland. In addition, six parrots and samples from one bird feeding table were analysed with negative results.

Humans

In 2013, 24 cases of psittacosis were reported. All of these cases were reported as domestic except for one who acquired the infection in Somalia. Five of the cases were women of the ages of 34 to 64 and 19 cases were men aged 33 to 88 years. Half of the cases (14) had reported being in contact with birds. Two of the cases were healthcare workers, most probably infected when treating patients with confirmed psittacosis. The rest of the cases (8) had no obvious route of transmission. A majority of the cases (79%) were reported from two of the southernmost counties in Sweden, Skåne and Kronoberg. An investigation was conducted in these counties to find out the cause of the outbreak.



Photo: SVA

DISCUSSION

At present, *C. psittaci* does not occur in Swedish poultry. The organism is occasionally reported in caged birds but psittacosis is considered common in both caged 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. Surveys performed in other countries suggest that the number of human cases of psittacosis is underestimated. Detection methods are not sensitive enough.

The investigation of the increase in human cases in southern Sweden identified contact with wild bird droppings, mainly through cleaning of bird feeders,

as the likely source of infection. A few cases had no known exposure to birds and had been in contact with another confirmed case, suggesting human-to-human transmission.

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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 having 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 ani-

mals 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 2013. Limited testing was done on cattle and sheep for export reasons. Blood samples from 9 cattle and 9 sheep were analysed for the presence of antibodies by an indirect ELISA (CHEKIT Q-fever), and from 17 cattle and 3 sheep by complement fixation test. Five cattle herds were investigated for presence of antibodies in bulk milk by indirect ELISA (CHEKIT Q-fever). One of the herds was tested due to clinical suspicion. In addition, two cattle and 5 sheep were tested for the agent by PCR in conjunction with surveillance for *Brucella* spp. in aborted material.

Humans

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

RESULTS

Animals

Two blood samples from cattle from one herd and one bulk milk sample from a different herd were positive for antibodies to Q fever. All other samples from cattle and sheep 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 2013, four cases of Q fever, three men and one woman, were reported. One of these cases was reported as domestic; however the infection might have been acquired in Spain. For the remaining cases during 2013, countries of infection were Spain, Iraq and Ethiopia with one case reported from each country.

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 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

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 dog. The reservoir animal species for rabies in endemic countries are wild carnivores or stray dogs. In Europe, the reservoir species are red foxes and raccoon dogs. Bats in Europe may carry another type of rabies virus called European Bat Lyssa virus (EBLV), but not classical rabies. Since 1886 Sweden has been free from animal rabies. EBLV has never been isolated from bats in Sweden.

Disease

Humans and animals

Rabies virus infects the central nervous system of humans and mammals. Early symptoms of rabies are nonspecific, consisting of fever, headache, and general malaise. As the disease progresses, neurological symptoms appear and may include: insomnia, anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation and difficulty swallowing. 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 the EU Regulation 998/2003 until 28th December 2014 and in EU Regulation 576/2013 thereafter.

Humans

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

SURVEILLANCE

Animals

Since 1998, a passive surveillance programme has been in place where dead bats have been examined for the presence of rabies virus. In addition, since 2008 an active surveillance programme has been performed in different regions in Sweden.

Passive surveillance

During 2013 there has been no programme for enhanced passive surveillance in bats. Nevertheless, ten dead or wounded and euthanized bats were sent to the National Veterinary Institute (SVA) for rabies examination (Map 5). The diagnostic methods used were based on the detection of antigens in brain tissue by use of a fluorescent antibody test (FAT) (4 specimens) or PCR (6 specimens). The bats were sent to the Swedish Museum of Natural History, Stockholm, to determine the species.

Two cats, four dogs and two red foxes were examined for rabies using FAT due to clinical suspicion. If the specimen was in poor condition due to decomposition, a PCR was performed as well.

In addition, 18 dogs, 1 raccoon and 4 cats, all illegally imported, were euthanized and examined for rabies after a decision by the Board of Agriculture. The diagnostic methods used were FAT (8 specimens) or PCR (15 specimens). None of the animals had presented clinical signs associated with rabies.

Active surveillance

Thirty-six Daubenton's bats (*Myotis daubentonii*) and two Brown long-eared bats (*Plecotus auritus*) were captured in the region of Skåne by using mist nets. The places were chosen by identifying rivers or creeks with good places for the nets. Blood samples

and oral swabs were taken and the species, sex and age were determined. After sampling, the bats were banded and released.

For serology the FAVN-method with EBLV-2 virus was used. The swabs were analysed by real-time PCR for EBLV 1 and 2 and classical rabies virus (RABV).

Humans

The surveillance in humans is passive.

RESULTS

Animals

All animals tested negative for rabies.

The surveillance activity in July 2013 was not performed as planned. Due to low numbers of bats in the different habitats only 1/3 of the planned 100 Daubenton's bats were caught and sampled. Two Brown long-eared bats were sampled as well. The reason for the low number of samples is not known, but the weather conditions may have affected the population. The winter was long and the summer very dry in this region of Sweden.

Humans

No human cases were reported during the year.

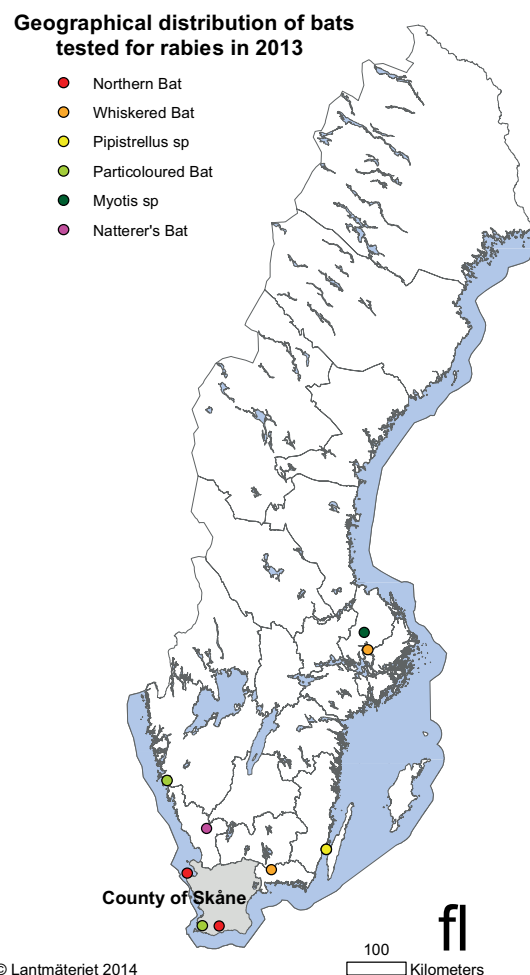
DISCUSSION

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. There has been an increasing problem with illegal importation of pets since 2004, mostly dogs. Illegally imported dogs are probably the greatest threat to the rabies free status of Sweden even though the risk of introducing rabies is rather low.

In recent years, antibodies to EBLV have been detected in specimens from live Daubenton's bats suggesting that EBLV is present in Sweden. Daubenton's bat (*Myotis daubentonii*) with EBLV-2 infections 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 18 different species of bats in Sweden, all insectivorous belonging to the family of *Vespertilionidae*. There was no enhanced passive surveillance in 2013 and there will not be one in 2014. This hiatus might reduce the quality of the surveillance as the system depends on the willingness to send in samples.

Map 5. Distribution of bats tested for rabies in passive surveillance during 2013



Salmonellosis

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 any part 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 3,000-4,000 human cases of salmonellosis are reported every year to the former Swedish Institute for Communicable Disease Control, now The Public Health Agency of Sweden. A majority of these (around 80-85%) are infected abroad. The low proportion of domestic infections is unique for Sweden compared to many other countries. Few larger outbreaks are reported and the source is typically 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 herds and horses, but only rarely in swine herds and poultry flocks.

Humans

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

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 treat-



Photo: SVA

ment process and preventive measures for preventing recontamination 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 mills manufacturing compound feeding stuffs feed for poultry and a minimum of two samples from those manufacturing compound feeding stuffs for other food-pro-

ducing 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 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 above 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 22,000 samples from cattle, adult swine, fattening pigs and poultry are collected annually at abattoirs.

At red meat cutting plants, approximately 6,000

Table 13. 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 15th week (start at 22-26 weeks)	2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year
Poultry for meat production (all species)		2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year

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 850 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 having more than 250 birds are tested (Table 13). 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.

All holdings selling eggs for consumption are sampled (Table 13). 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 Vet-

erinary 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. Animals purchases 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. All broiler flocks are analysed for *Salmonella* before slaughter. Positive flocks are destroyed.

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. At necropsy, all calves younger than six months are

tested for *Salmonella*. *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 the National Veterinary Institute are tested for *Salmonella*.

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 former Swedish Institute for Communicable Disease now 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 primary isolates of *Salmonella* from non-human sources are sent to the National Veterinary Institute for confirmation, resistance testing, serotyping and further typing. Primary isolates of *Salmonella* from humans are sent to the former Swedish Institute for Communicable Disease now the Public Health Agency of Sweden for serotyping, phage typing and further molecular typing.

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 serotype. 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 stamping out of groups of animals and hygienic measures controlled by repeated sampling is usually practiced. Hygienic measures can include reducing the number of animals, control of animal feed and manure movements on the farm and reduction of *Salmonella* in the environment by cleaning and disinfection. No *Salmonella* positive animals should enter the cleaned and disinfected parts of the stable. Negatively tested animals, when considered at low risk of being infected, may be slaughtered under certain conditions with extra hygienic measures and sampling of each carcass. The restrictions are lifted when the cleaning and disinfection have been completed and

Salmonella cannot be detected from two whole-herd samplings for culture performed four weeks apart. If *Salmonella* is detected in companion animals advice is given to the owners. If *Salmonella* is detected in horses, the stables and/or the paddocks at risk are put under restrictions and the horse is followed up.

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.

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

Thirteen major feed mills produce approximately 95% of the feed for food producing animals. In the weekly surveillance of feed mills, 8, 735 samples were analysed for *Salmonella* with 33 samples (0.38%) positive. Sixteen serotypes were detected; *S. Mbandaka* was the most common (n=9) (Table 14).

In addition, *Salmonella* was detected in 18 (0.7%) out of 2,697 samples from feed materials of vegetable origin. The most common serotype was *S. Senftenberg* (n=3). *Salmonella* was detected in eight environmental samples from domestic rapeseed processing plants. *Salmonella* was detected in 5 (0.4%) out of 1,370 samples from feed materials of animal origin and from pet food.

Animals

Poultry

Salmonella Typhimurium was detected in one flock (0.03%) of 3,276 broilers in routine sampling before slaughter (Table 15). In addition, *S. Typhimurium* was detected in seven (1.1%) of 636 flocks of layers. All these infected flocks were from one holding. *Salmonella* was not detected from any other poultry species.

Cattle

In 2013, feed contaminated with *S. Mbandaka* was delivered from a feed factory to more than 150 herds with cattle, sheep or horses. All these herds were sampled and *S. Mbandaka* was detected in 10 cattle herds but not in any holdings with sheep or horses. The herds were put on restrictive measures.

In summary, *Salmonella* was detected in fifteen new herds (Table 16);

- 11 herds were detected by tracings of the contaminated feed from a feed mill.
- 2 herds were detected by trace-back investigations from a *Salmonella* positive herd.
- 1 herd was detected by post mortem examination of a diseased calf.
- 1 herd was detected by sampling before sale.

In addition, *Salmonella* was isolated from five farms put under restrictions before 2013.

Salmonella was isolated from 3 of 3,522 mesenteric lymph nodes from cattle at slaughter (Table 17, Figure 7).

Pigs

In 2013, *Salmonella* was not detected in any of the 40 breeding herds or other pig herds sampled after a finding in the abattoir control programme (Figure 13).

Salmonella was detected from 2 of 2,432 lymph node samples taken from adult pigs (Table 17, Figure 8) and from 4 of 2,975 lymph node samples from fattening pigs (Figure 9).

Other animals

In 2013, *Salmonella* was detected in 150 cats (Table 18). Most of these were reported from January to May. Of the 43 serotyped cat isolates, 42 belonged to Typhimurium and one to Infantis.

An outbreak of *S. Enteritidis* was detected among hedgehogs on the island of Gotland, with 15 notified cases. In addition, *Salmonella* was detected in five dogs, two horses, 24 wild birds and nine other wild mammals than hedgehogs (Table 18).

Food

In the Swedish *Salmonella* control programme, *Salmonella* was detected in two of 3,475 cattle carcass samples and from one of 5,379 pig carcass samples (Table 17). *Salmonella* was not isolated from any of the 4,900 poultry neck skin samples or 6,527 samples from cutting plants (Table 17, Figure 10).

Table 14. Serotypes of *Salmonella* isolated in feed control in 2013

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. Agona</i>			1		1	
<i>S. Anatum</i>	1					
<i>S. Bareilly</i>			1			
<i>S. Brandenburg</i>					1	
<i>S. Cerro</i>					1	
<i>S. Cubana</i>					1	2
<i>S. Derby</i>	1					
<i>S. enterica</i> subsp.	1	1	4		1	
<i>S. enterica</i> subspecies <i>diarizonae</i> (IIIb)					1	
<i>S. Glostrup</i>					1	
<i>S. Havana</i>			1			
<i>S. Infantis</i>		1			1	
<i>S. Livingstone</i>			1			
<i>S. Mbandaka</i>			2		9	2
<i>S. Rissen</i>			2		2	
<i>S. Ruiru</i>			2			
<i>S. Schwarzengrund</i>			1			
<i>S. Senftenberg</i>			3		2	4
<i>S. Soerenga</i>					1	
<i>S. Tennessee</i>			2		1	
<i>S. Typhimurium</i>					8	
<i>S. Weltevreden</i>					1	
<i>S. Yoruba</i>					1	
TOTAL	3	2	20^C	0	33	8
(total number of samples)	1,289	81	2,553	144	8,735	750

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.

C - 18 positive samples, two different serotypes in two samples.

Table 15. 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	15	0	0.00%	
<i>Gallus gallus</i>	Meat production	Adult Parent	119	0	0.00%	
<i>Gallus gallus</i>	Meat production	Production	3,276	1	0.03%	<i>S. Typhimurium</i>
Turkeys	Meat production	Adult Parent	4	0	0.00%	
Turkeys	Meat production	Production	184	0	0.00%	
<i>Gallus gallus</i>	Egg production	Adult Parent	21	0	0.00%	
<i>Gallus gallus</i>	Egg production	Production	636	7	1.10%	<i>S. Typhimurium</i>
Geese	Meat production	Production	23	0	0.00%	
Ducks	Meat production	Production	7	0	0.00%	

Available results from official sampling by local authorities at food enterprises showed that 894 samples for *Salmonella* were taken for reasons other than the *Salmonella* control programme. Three of these 894 samples were positive.

A project designed to investigate compliance with the *Salmonella* guarantees stated in Commission Regulation (EC) No 1688/2005 was carried out during 2012. Document checks were performed on 132 consignments at receiving establishments by personnel from both the National Food Agency and several Swedish municipalities. Thirty-three of these consignments were tested for *Salmonella*. This report, report nr 15 2013 in the report series 1994-2014, was published during 2013.

Humans

During 2013 a total of 2,838 cases of salmonellosis were reported (Figure 11), compared to 2,917 cases in 2012. Domestic cases decreased by 3% to 651 cases, an incidence of 6.7 cases per 100,000 inhabitants.

A majority of the cases in 2013 (76%) were infected abroad. Travel-associated cases decreased by 3% compared to 2012, to 2,166. In the long run, the travel-associated cases have decreased, despite an increase in international travel. Number of cases infected abroad has been decreasing since the beginning of 2000 and during the years 2011-2013, the travel-associated cases have been the fewest during this period. The observed decrease has been most

clear for those travelling within Europe. As in previous years, *Salmonella* infection was most commonly acquired in Thailand (668 cases) followed by Turkey (326), Egypt (148), Spain (111), Tunis (71) and India (66).

Among the domestic cases, the median age was 37 years. Children aged 0-9 years accounted for 19% of the domestic cases and for 16% of the travel-associated cases. The gender distribution was even for the travel-associated cases but slightly more women than men (54 %) were reported among the domestic cases.

Among the domestic cases, 92% of the isolates were serotyped compared to 13% for the travel-associated cases. *S. Typhimurium* was most common among the typed domestic isolates (22%) followed by monophasic *S. Typhimurium* (*S. enterica* sp. *enterica* 1,4,[5],12:i:-) (14%) and *S. Enteritidis* (12%). Among domestic isolates of *S. Enteritidis*, phage types 8, 4, 21 and were most common. During 2013, phage typing of isolates of *S. Typhimurium* was completely replaced by MLVA analysis. Among the domestic cases of *S. Typhimurium*, MLVA profile 2-13-3-NA-212 was the most common (13 cases), whereas for domestic cases of monophasic *S. Typhimurium*, MLVA profile 3-12-9-N-211 was the most common (20 cases). *S. Enteritidis* accounted for 42% of the isolates typed from travel-associated cases. In Sweden, *S. Typhimurium* is the most common domestic serotype, whereas in most European countries it is *S. Enteritidis*.

Table 16. Cattle herds infected with *Salmonella* in 2013

Primary serotype	Restricted since	Restrictions lifted	Reason for sampling
S. Dublin	2008	not	Necropsy
S. Dublin	2009	not	Screening survey
S. Dublin	2012	not	Necropsy
S. Dublin	2012	not	Trace-back
S. Dublin	2013	not	Necropsy
S. Dublin	2013	not	Trace-back
S. Dublin	2013	not	Trace-back
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	2013	Tracing contaminated feed
S. Mbandaka	2013	not	Tracing contaminated feed
S. Typhimurium	2012	not	Abattoir sampling control programme
S. Typhimurium	2013	2013	Tracing contaminated feed
S. Typhimurium	2013	not	Sampling before sale

Salmonella cases are reported with a clear seasonal variation with most cases during the summer months. In 2013, the number of reported cases increased during July–September. Most travel-associated cases were reported during January to March when travelling to warmer destinations is common, but in 2013 there was a clear peak during the summer months when many people are having their vacation.

During 2013, only six domestic small outbreaks of *Salmonella* were reported. The In 2012, 14 outbreaks were observed. Outbreak investigations were challenging and unfortunately, the source could seldom be determined. In November 2013, there was an increase of *S. Coeln* in Sweden (5 cases). Simul-

taneously, there was an outbreak of *S. Coeln* in Norway (25 cases). The epidemiological study in Norway suggested mixed salad from a specific company. In the investigation, it was found that one ingredient from the salad mix (red chard) had been distributed from the company to Sweden. A different batch of the salad, than the batch which was on the market during the incubation period, was sampled and analysed but no *Salmonella* could be identified. Also in 2013, an international outbreak of *S. Mikawasima* was reported in November, and the increase of cases was also noticed in Sweden (7 cases). Interestingly, some patients in this outbreak were hospitalized during the incubation period. However, but no common source of exposure has been found.

DISEASE SURVEILLANCE 2013

Table 17. Results from the *Salmonella* control programme at slaughterhouses and cutting plants in 2013

Animal species	Sample type	No. samples	Positive	Percentage (%)	Serotype
Cattle	Lymph node	3,522	3	0.09%	<i>S. Typhimurium</i> , <i>S. enterica</i> O4:i:-
	Carcass swab	3,475	2	0.06%	<i>S. Infantis</i> , <i>S. enterica</i> sp. <i>diarizonae</i> =38:r:z35
Breeding swine	Lymph node	2,432	2	0.08%	<i>S. Infantis</i> , <i>Typhimurium</i> (n=2)*
	Carcass swab	2,447	0	0.00%	
Slaughter swine	Lymph node	2,975	4	0.13%	<i>S. Typhimurium</i> (n=4)
	Carcass swab	2,932	1	0.03%	<i>S. Typhimurium</i>
Cattle and swine	Meat scrapings	4,823	0	0.00%	
Poultry	Neck skin	4,900	0	0.00%	
	Meat scrapings	927	0	0.00%	

* *Typhimurium* was isolated from one pooled sample of lymph nodes, *Infantis* from the re-isolation

Table 18. Reported cases of *Salmonella* in cats, dogs, horses, wild mammals and wild birds in 2013

Serotype	Cats	Dogs	Horses	Hedge-hogs	Foxes	Bears	Lynx	Roe deer	Moose	Wild birds
<i>S. Brandenburg</i>		1								
<i>S. Enteritidis</i>			1	15						
<i>S. Fulica</i>										1
<i>S. Infantis</i>	1	1								
<i>S. Konstanz</i>						1				
<i>S. Newport</i>					1					
<i>S. Reading</i>		1								
<i>S. Typhimurium</i>	42	1	1		3		1	1		19
<i>Salmonella enterica</i> sp <i>diarizonae</i> =50:z52:-					1					
<i>Salmonella enterica</i> sp <i>diarizonae</i> =38:r:z35									1	1
<i>Salmonella enterica</i> sp <i>enterica</i> (I) =3,10:y:-		1								
<i>Salmonella enterica</i> sp <i>enterica</i> (I) = 4,5:-:1,5										2
<i>Salmonella enterica</i> sp <i>enterica</i> (I) = 8:-:enx										1
<i>Salmonella</i> , not serotyped	107									
Total	150	5	2	15	5	1	1	1	1	24

Figure 7. *Salmonella* in lymph node samples of cattle sampled at slaughterhouses.

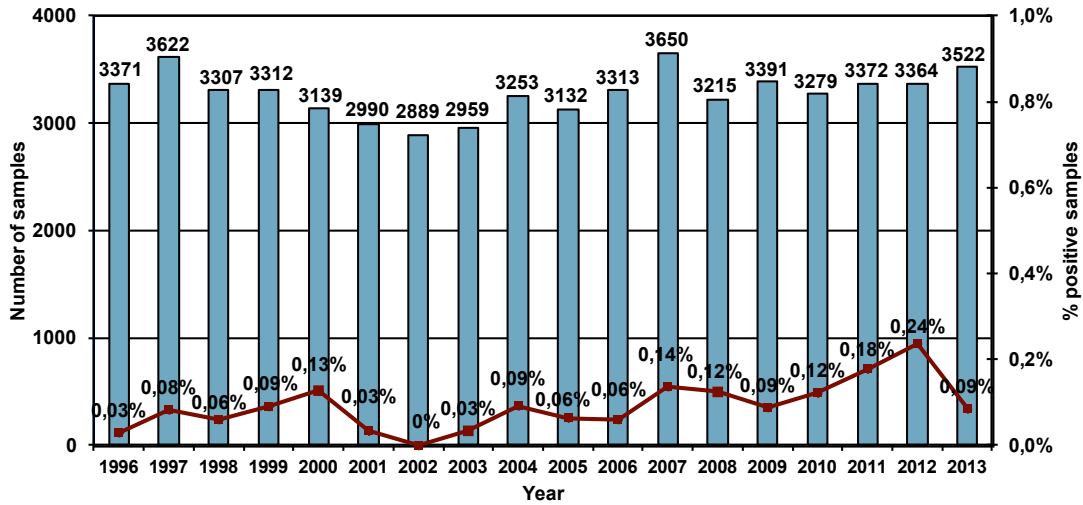


Figure 8. *Salmonella* in lymph node samples of adult swine sampled at major slaughterhouses.

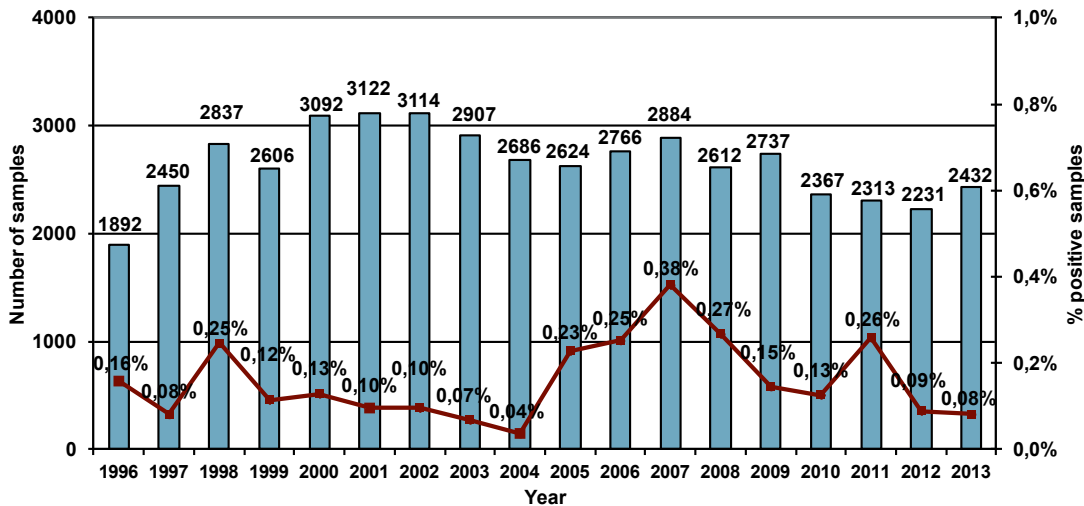


Figure 9. *Salmonella* in lymph node samples of fattening pigs sampled at slaughterhouses.

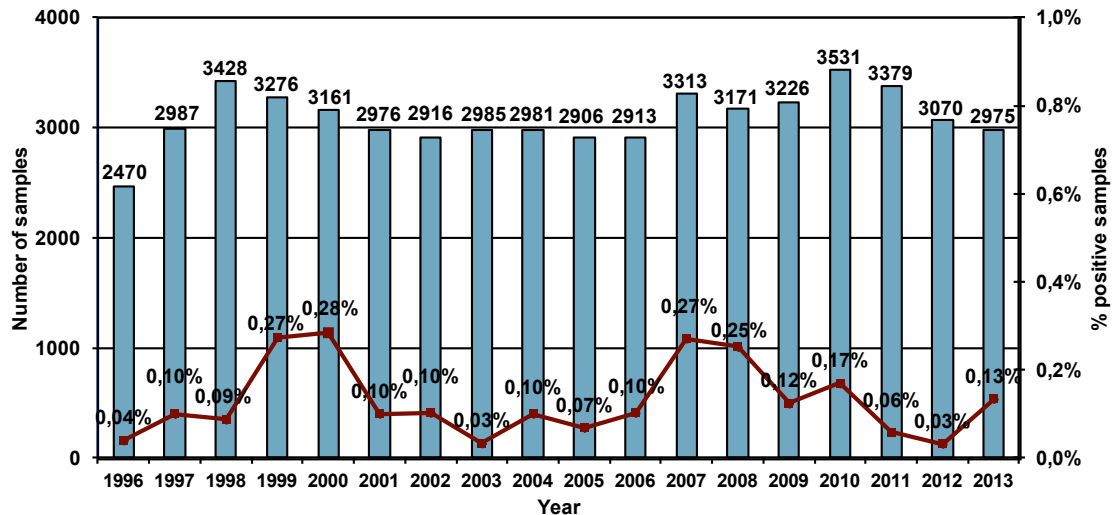


Figure 10. *Salmonella* in neck skin samples of poultry sampled at major slaughterhouses.

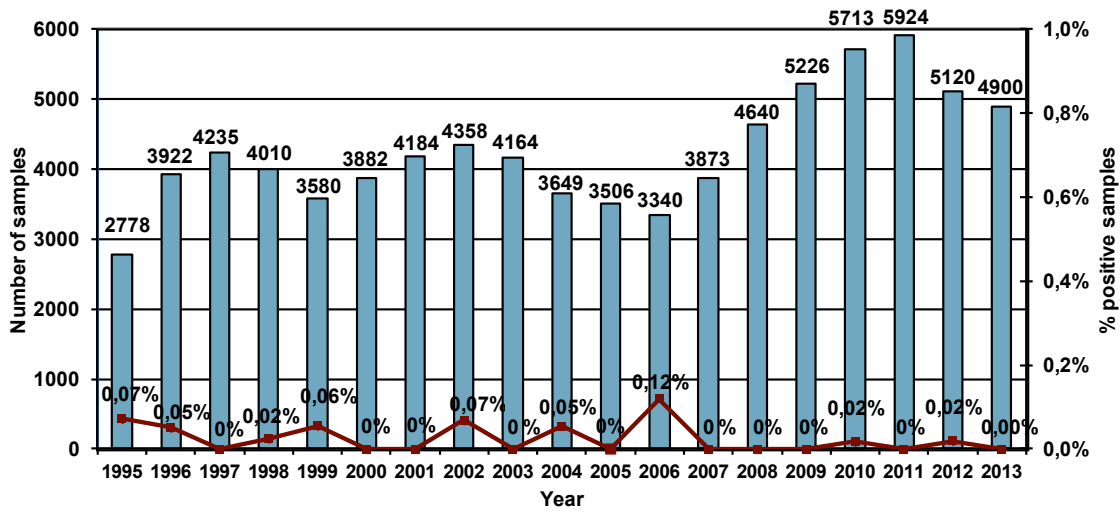
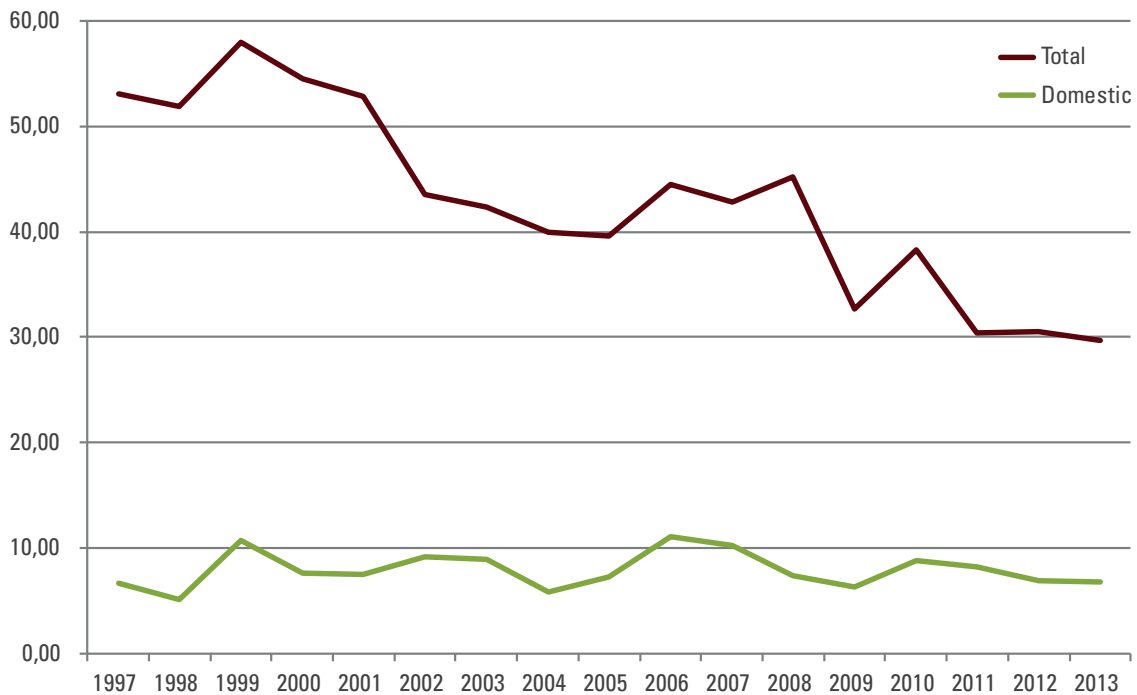


Figure 11. Notified incidence (per 100,000) of human salmonellosis in Sweden, 1997-2013.



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 to report both the total incidence and domestic incidence in humans. The total notified incidence in 2013, 29.4 cases per 100,000 inhabitants is considerably higher than the domestic inci-

dence of 6.7 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 2013 showed that *S. Mbandaka* was the most frequently isolated serotype in the weekly surveillance of feed mills (n=9). This can be attributed to a feed borne outbreak in one medium sized feed mill during the spring 2013.



Photo: Bengt Ekberg, SVA

When *Salmonella* was isolated after heat treatment, there was an immediate stop of production. Cleaning and disinfection as well as follow up procedures were carried out before the production was resumed. In 2013, more cattle herds (n=15) were detected with *Salmonella* compared to the three previous years but nearly as many as in 2009 (n=19). In 2008, a bulk milk screening for *Salmonella* was performed and this revealed more infected herds. In 2009 extensive samplings were performed during a *Salmonella* outbreak in the county of Skåne. Less sampling of cattle herds rather than decrease in the number of infected herds seems to be the reason for detection of fewer cattle herds. In 2012, the county of Skåne detected its first cases of *Salmonella* Dublin in two cattle herds. The source of this infection has not been determined. In 2013 *Salmonella* Dublin was detected in another three herds in the county of Skåne. The epidemiological connection between the two herds detected in 2012 and the three herds detected in 2013 is not completely determined. The investigation is ongoing.

During 2013, *Salmonella* was not detected in any pig herds. 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.

Reported domestic human cases of *Salmonella* vary from year to year depending on the number of outbreaks. The total number of reported human cases has significantly decreased from 1997-2009, but this trend could not be identified for the domestic cases. 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 for the last six years and is considered to be the result of the harmonised *Salmonella* control programmes in poultry.

Thailand is the most common country for travel-associated *Salmonella* measured by cases per travel events. A decrease in the incidence of Thai travel related salmonellosis has also been observed. However, information to travellers about risks of con-

tracting *Salmonella* and other infectious diseases remains necessary 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.

Investigations of the 2013 national outbreaks of *Salmonella* were difficult and did not reveal any confirmed sources. It was challenging to confirm suspected food sources as sampling delay resulted in the actual batch not longer being available on the market.

As the patients were living across the country, the outbreaks were most likely caused by food items widely spread in Sweden. The causative sero and phage types of the 2013 outbreaks have rarely been observed in domestic human cases or animals. This indicates that contaminated imported food items were the most likely sources. Also, statistics of domestic outbreaks over time confirms that very few outbreaks are caused by food items originating from Swedish raw materials.

An increased awareness regarding the risk of *Salmonella* in imported food, especially leafy green vegetables is needed as these products are commonly not cooked or heated prior to eating.

Routine MLVA subtyping isolates of *S. Typhimurium* from humans and comparison with isolates from animals, food, feed and the environment

has proved to be a useful tool to detect clusters and outbreaks. PFGE is another useful molecular tool to identify sources in outbreaks and to connect cases to outbreaks, both with historical cases and with present cases as seen with the outbreak of *S. Java*.

Monophasic *Salmonella* (*S. enterica* sp. *enterica* 1,4,5,12:i:-) has become more common in recent years in Sweden and in other European countries which has led to ongoing investigations. In order to better understand this emerging type, a joint national project between the human and veterinary institutes started in 2010.

The Swedish *Salmonella* control programme has been in place for decades. It is extensive and the continuous work has resulted in a very low *Salmonella* burden in domestic animals (Figures 12-15). However, the programme is costly and could be modernised. In 2013, the Swedish Board of Agriculture, the National Food Agency, the former Swedish Institute for Communicable Disease Control now the Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute published a new 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.

Figure 12. Notified incidence of *Salmonella* in Swedish cattle herds during 1968-2013.

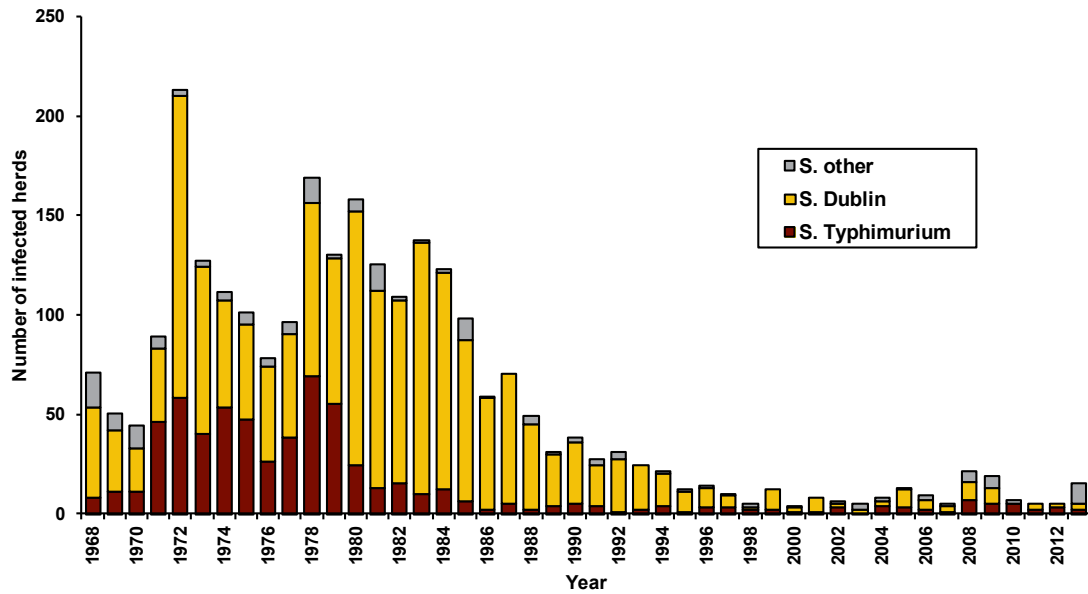
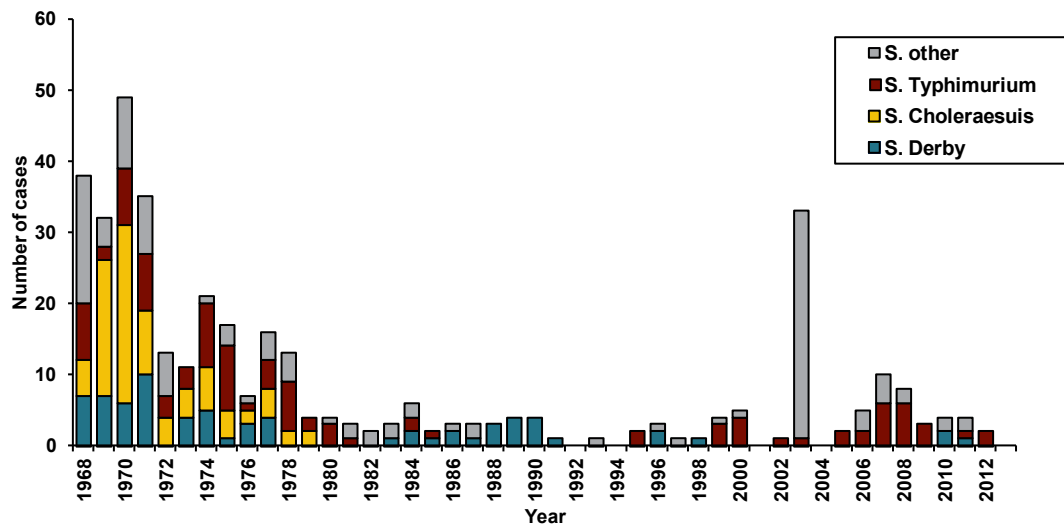


Figure 13. Incidence of *Salmonella* in swine herds during 1968-2013.



2003: S other: 30 of 32 herds infected by S.Cubana in outbreak related to contaminated feed

Figure 14. Notified incidence of *Salmonella* in layer holdings during 1968-2013.

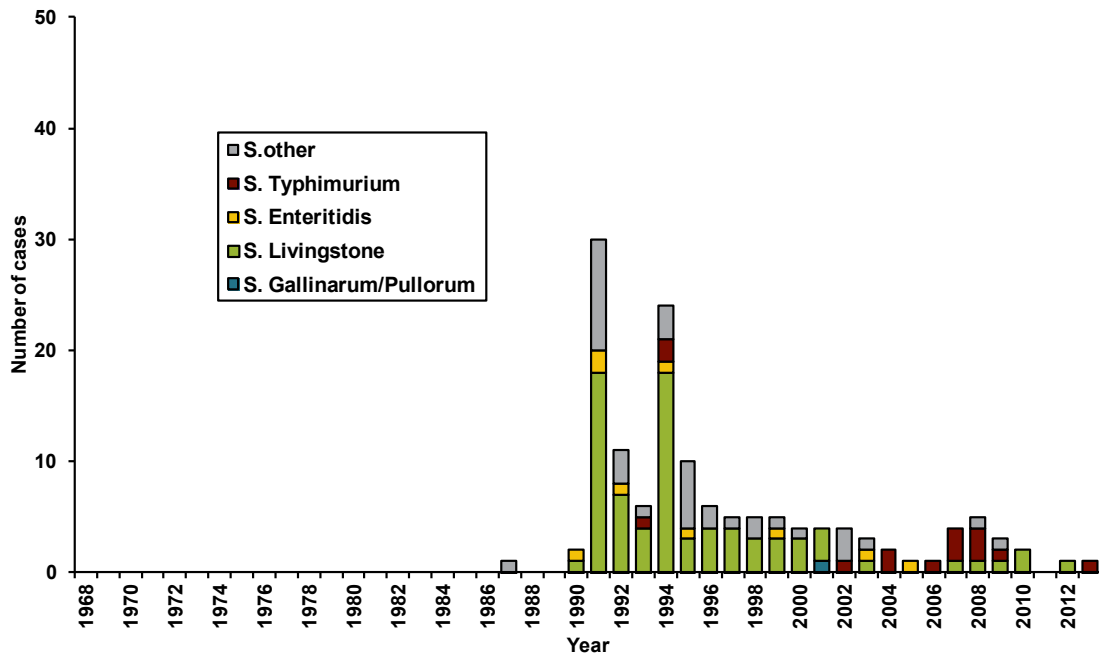
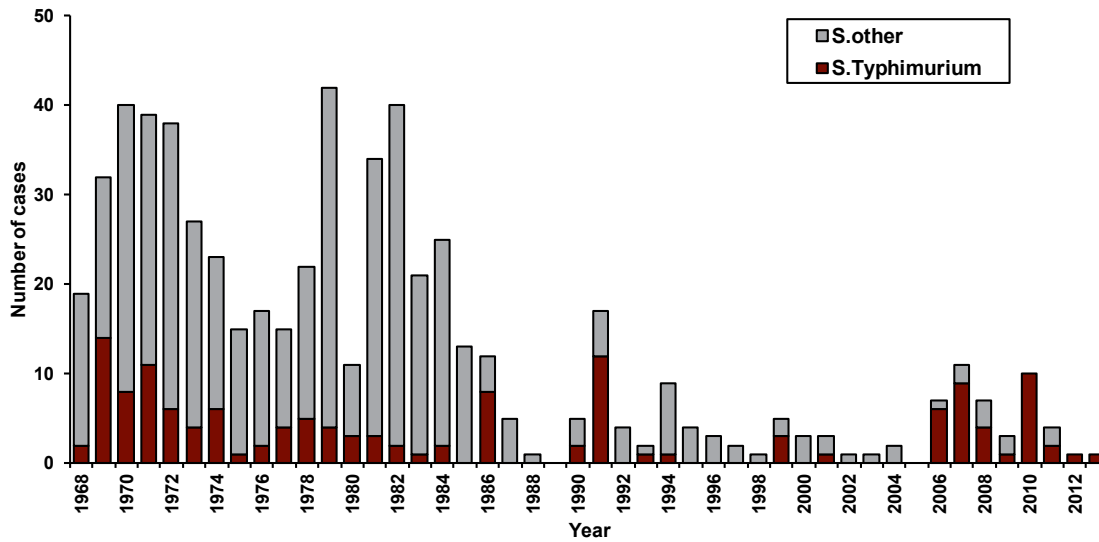


Figure 15. Notified incidence of *Salmonella* in broiler holdings during 1968-2013, breeding flocks included.



2006-07: outbreak of *S. Typhimurium*

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 prion-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.

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; 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 may be a spontaneously occurring disease.

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 regu-

lated 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, amended through SJVFS 2011:29 (and 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 2013, two sheep from one herd were examined due to clinical suspicion of scrapie. Both were negative.

Active surveillance

Sheep

In 2013 the National Veterinary Institute examined 7,470 sheep from fallen stock for scrapie. Out of these, all samples were negative for classical scrapie and three were positive for atypical scrapie Nor98. In addition, nine sheep were examined at slaughter within the framework of intensified surveillance in flocks with positive cases of atypical scrapie (Regulation (EC) 999/2001), all these were negative for both classical and atypical scrapie.

Goats

In 2013 the National Veterinary Institute examined 19 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 65,000 sheep have been tested without any positive cases detected. There is no central register for individual sheep and thus the number of dead animals cannot be compared to the number of sampled animals. Despite the fact that, not all sheep are collected and some are too autolysed to be sampled during the warmest summer months, the animals tested in 2013 constitute approximately 2.4% of the population of adult sheep. The results support the freedom, or very low prevalence of classical scrapie in the country.

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, in total 31 cases have been detected up to the end of 2013. 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. However, transmission studies have shown that atypical scrapie can be transmitted to sheep and other species under experimental conditions. 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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Photo: SVA

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 and 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 were performed using ELISA and positive results were confirmed with a serum neutralisation (SN) test.

At present, SVD active surveillance is performed every second year.

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

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 the Swedish Animal Health Service 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 with a design prevalence (between herd) of 1%, a within herd prevalence of 20% and a risk of introduction of 1 in 50 years. Sample size is calculated to reach a probability of freedom of 99% at the end of the year.

To reach this level of probability of freedom 550 samples over the year (1 samples per herd from 550 herds) is needed (based on structure of the pig production 2012).

RESULTS

Passive surveillance

No clinical suspicions of SVD were investigated during 2013.

Active surveillance

Serum samples from 305 pigs were analysed and in none of them antibodies to SVDV could be found. The number of samples tested was considerably lower than planned. Taking into account the outcome of the surveillance, the probability of freedom at the end of 2013 was 98% and the sensitivity of the surveillance was 46%.

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 heavy structural changes leading to a rapidly declining number of herds and extensive changes in the market and in the habits of farmers. These changes partly explain the difficulties in managing the active surveillance in terms of planning design and number of samples. Discussions are ongoing within EU and OIE concerning the status of this disease.

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 is also circulating in the tick population through transovarial transmission without involvement of vertebrate hosts. Large species of mammals, predominantly ungulates, are important to maintain 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-1980's a clearly increasing trend has been observed. In recent years about 200-300 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. The age distribution is wide but most of the cases are between 30 and 70 years. There is a slight overrepresentation of men. About 80% of the patients are diagnosed in July to October.

DISEASE

Animals

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 surveillance in animals.

Humans

The surveillance is passive in humans.

RESULTS

Humans

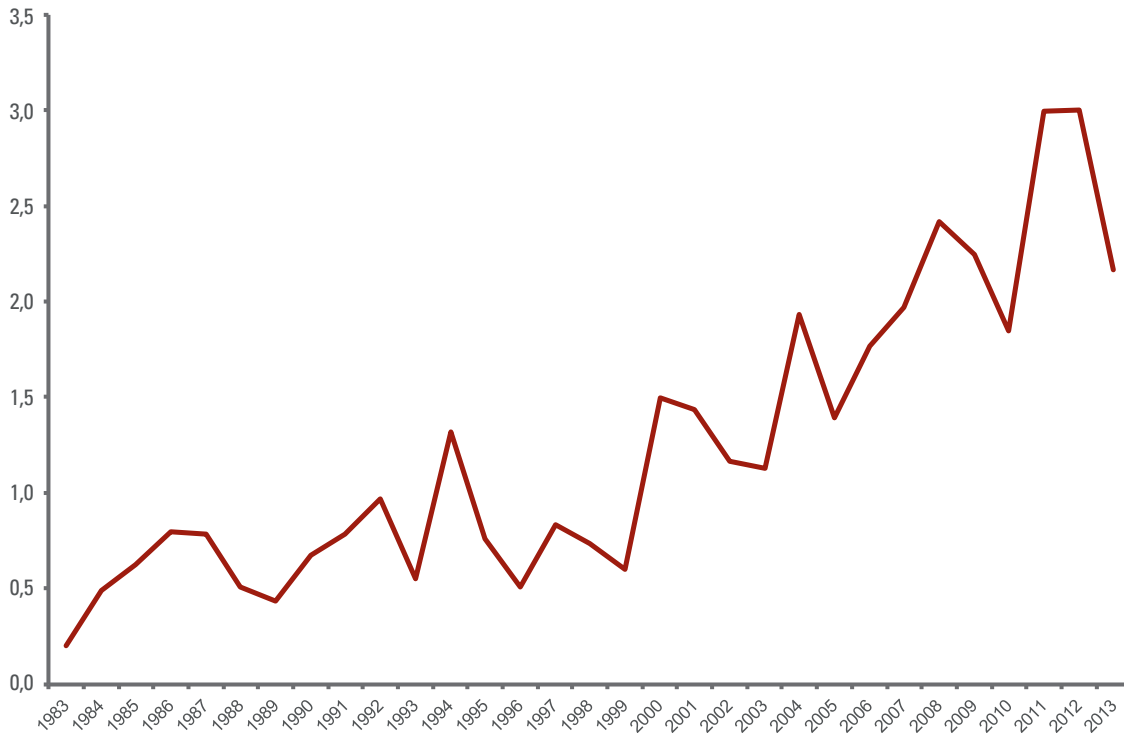
In 2013, 209 cases of TBE were reported, which is a slight decrease compared to 2012 (288 cases) (Figure 16). More men (60%) than women were identified with TBE. The disease was most common among people in the age group 40-69 years, but there were cases reported from the age of 2 to 90 years of age.

All but three cases had acquired their infection in Sweden. The others had been infected in Finland, Latvia and in Slovenia.

The first TBE cases became ill in May and the last in the beginning of December, but the peak occurred in July and September.

The geographic distribution of the disease was mainly, as in previous years, concentrated in the coastal areas of Stockholm, Södermanland and Upp-

Figure 16. Notified incidence of TBE (cases per 100, 000) in humans 1983-2013.



sala counties, both along the lake of Mälaren and the Baltic Sea. The incidence was highest in the county of Södermanland (10 cases per 100,000 inhabitants). There were also cases infected close to the two big lakes of Vänern and Vättern, as well as along the Swedish west coast from Gothenburg in the south and with a northward spread. As in previous years, occasional cases were infected along the coastline in Kalmar, Blekinge and Skåne counties. The northernmost reported cases had acquired the infection in the southern part of Gävleborg county.

DISCUSSION

The large increase in the number of TBE cases seen in Sweden in 2011-2012 was probably due to sev-

eral interacting factors. The most important cause was presumably the very dense population of ticks, a consequence of a large roe deer population from the 1980s up until the recent snowy winters, 2009-2010 and 2010-2011. This situation in combination with many small host animals, for example bank voles, at times as well as optimal weather for both virus spread and humans spending time outdoors, could explain the large number of cases reported.

There is no obvious reason to why the number of TBE cases, during 2013 decreased compared to 2012. The number of cases can probably be connected to several interacting factors like population of host animals and the weather conditions during the winter of 2012-2013.

Trichinellosis

BACKGROUND

Trichinellosis is caused by parasitic nematodes of the genus *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 infected abroad. The most recent reported human case, in 2007, had consumed wild boar sausage imported privately from Spain. The previous case occurred in 2003 after consumption of cold-smoked ham in the Balkans. In 1997, there was also one travel-associated case.

DISEASE

Animals

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

Humans

The disease in humans and animals 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 domestic pigs and wild boars, horses, hunted wild boars and bears are tested for *Trichinella* by the digestion method. In addition, several species of wild animals are tested for *Trichinella*, including: foxes, lynxes, wolves, badgers, birds and wolverines. The testing is performed by eight laboratories.

Humans

Surveillance in humans is passive.

RESULTS

Animals

In 2013, all slaughtered domestic swine (2,454,297) and horses (3,585) were tested. *Trichinella* was not detected in domestic pigs or horses. *Trichinella* spp. was detected from three of 66,312 (0.0045%) wild boar samples and also from 8 lynx, 2 wolves, 5 bears, 4 foxes and 3 wolverines (Table 19). These figures are based on results from seven of the eight laboratories testing *Trichinella*.

Humans

During 2013, one possible domestic case of *Trichinella* was reported in Sweden. The clinical symptoms indicated that the case had trichinellosis but diagnostic tests have been inconclusive. Further diagnostic tests are ongoing to confirm the trich-

inellosis status of this potential case. 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 19. Findings of *Trichinella* in wild animals 2013*

Animal species	No. samples	No. positives	Percentage (%)	<i>T. britovi</i>	<i>T. nativa</i>	<i>T. pseudo-spiralis</i>	<i>T. spp.</i>
Badgers	4	0	0.00%				
Beaver	1	0	0.00%				
Arctic fox	4	0	0.00%				
Marten	2	0	0.00%				
Seal	2	0	0.00%				
Raccoon	1	0	0.00%				
Wild birds	54	0	0.00%				
Red foxes**	149	4	2.68%	2	3		
Lynx**	173	8	4.62%	1	7		1
Otter	23	0	0.00%				
Raccoon dogs	1	0	0.00%				
Wild boars	66,312	3	0.0045%	3			
Wolves	43	2	4.65%	1	1		
Wolverine	27	3	11.11%	1	1		1
Bears	289	5	1.7%		5		
Total		25		8	17		2

*Figures are based on information from seven of the eight laboratories testing *Trichinella*.

**Two species, *T. britovi* and *T. nativa* were detected in one sample.

Tuberculosis

BACKGROUND

Tuberculosis (TB) is a serious disease in humans and animals caused by bacteria included in the *Mycobacterium tuberculosis* complex. *Mycobacterium bovis* causes bovine tuberculosis in several animal species 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 about 6/100,000 inhabitants, which is among the lowest in the world. The vast majority of the cases occur in immigrants originating from countries that still have a high incidence of tuberculosis.

DISEASE

The symptoms caused by tuberculosis in both humans and animals depend largely on the localisation of the infection. The disease progresses slowly and 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 for up to twelve weeks. Microscopy of suspect colonies is performed and bacteria in the *M. tuberculosis*-complex are identified with a specific genetic probe. Positive isolates are further subtyped.

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

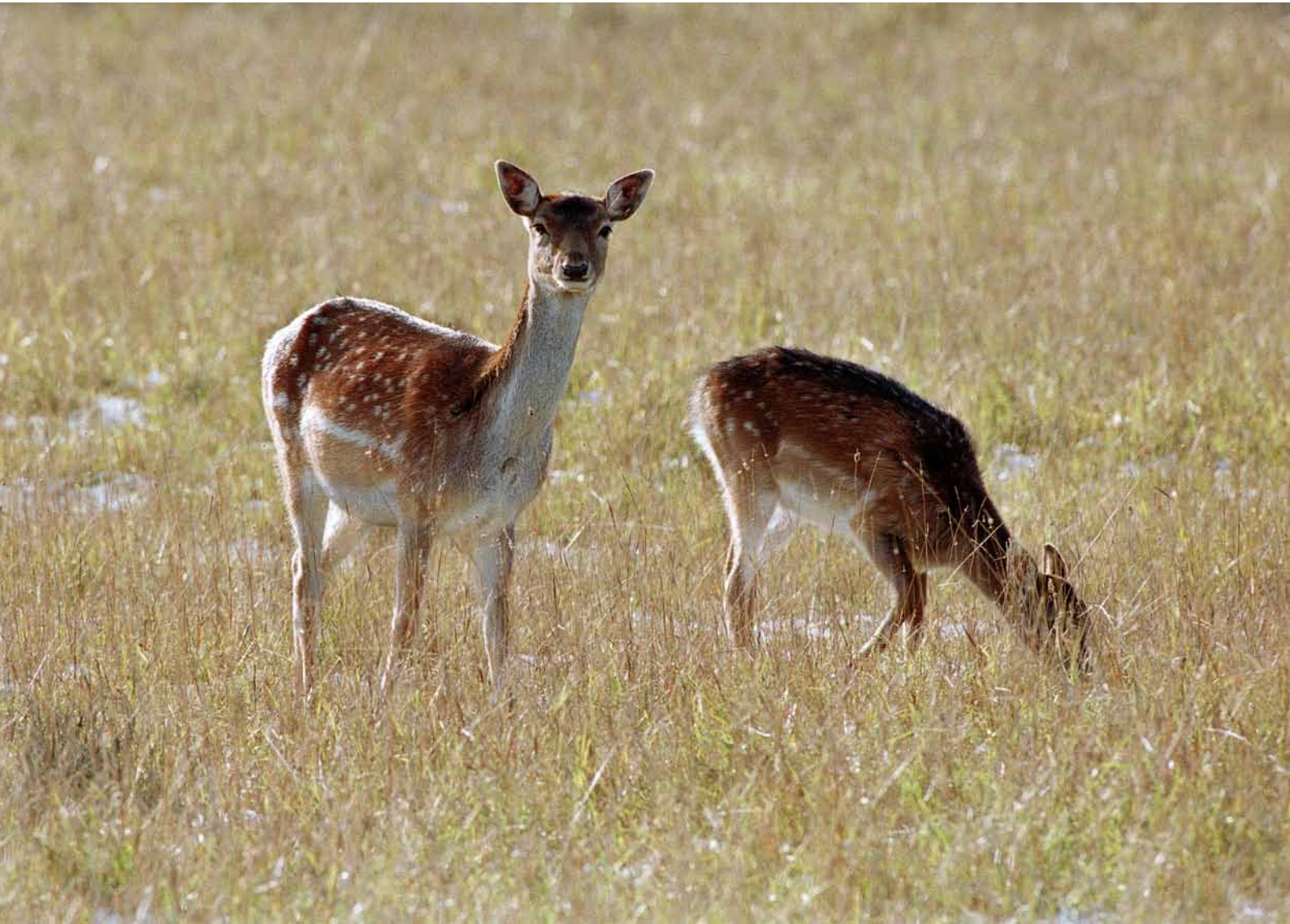


Photo: SVA

Humans

In humans sputum smear 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 reason to suspect exposure of animals to bacteria of the *M. tuberculosis*-complex.

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

Humans

The surveillance in humans is passive. 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 is no longer performed in TB-free herds, but inspections at slaughter and necropsy of animals found dead or euthanized are still required.

RESULTS

Animals

The number of animals investigated by histology and, if relevant, bacteriology, due to lesions detected at slaughter were 11 pigs, 4 cows, 3 deer and 2 sheep.

From these samples, bacteria from the *Mycobacterium avium/intracellulare*-complex were isolated in 8 pigs. No other samples yielded any mycobacteria.

Due to clinical suspicions or lesions found at necropsy, samples from two deer, one wild boar, one camel, one horse, two dogs and one cat were investigated. From these samples, bacteria from the *Mycobacterium avium/intracellulare*-complex were isolated in the wild boar. No other samples yielded any mycobacteria.

Approximately 600 holdings were registered for farmed deer, however a large proportion of these do not have deer anymore. The number of herds considered active, kept deer and had obtained TB free status, was 338. Ten 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 2013.

During 2012, a decision was taken to stop using the intra-dermal test in alpacas because of demonstrated low sensitivity in this species, and replacing it with serological test. During 2013, 7 alpacas were tested before export with negative final results.

In addition, one miniature hippopotamus was tested negative.

Humans

No cases of *M. bovis* were reported in humans in 2013.

DISCUSSION

Animals

The officially free status for bovine tuberculosis has been maintained during 2013. The overall TB situation in animals and humans remains favourable. No cases of TB were detected in Swedish animals during 2013. Although the surveillance is mainly dependent on inspections of slaughtered animals, this is considered to be 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 1940s 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

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 30-65 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, in recent years, tularaemia has been detected in the European brown hare in new geographic 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 septicemic 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 euthanised 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 2013, *F. tularensis* was detected from eleven European brown hares. Four of the hares were from Uppsala region, two from Stockholm, and the rest from Dalarna, Västergötland, Östergötland, Värmland and Kronoberg.

Humans

In 2013, 114 human cases of tularaemia were reported, which is considerably lower than the number of cases reported in 2012 (590 cases) (Figure 17). There are quite large natural fluctuations in the number of tularaemia cases observed between years and in different regions, which is probably due to several combined factors like the number of reservoirs and mosquitoes as well as the weather conditions.

More men (61%) than women were reported to be infected in 2013, which is in line with how it has been previous years. The incidence of tularaemia was highest in the age group 50-79 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.

All of the cases during 2013 were reported as domestic. As in previous years, except for a few sporadic cases, tularaemia was only reported from northern, western and central parts of Sweden. During 2013, most cases were reported from the counties of Örebro, Jämtland and Norrbotten.

A third of the cases were stated to have been infected via an insect bite and this proportion 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 2013, 9 cases were assumed to have been infected through direct contact with animals and 8 persons by drinking contaminated water.

During the first half of the year, just a few cases were reported in each month. The vast majority of the cases were reported in August to October,

Figure 17. Notified incidence (per 100 000) of human cases of tularaemia in Sweden 1997-2013





Photo: SVA

which is the usual seasonal distribution with a peak of cases in September or October. During the last two 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 infected south of the previous endemic region has increased. In animals, outbreaks of tularaemia have 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.

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 but most outbreaks and severe disease are caused by serotype O157:H7. Other common serotypes causing gastrointestinal illness are O26, O103, O111 and O145. Cattle are the main reservoir of VTEC associated with human disease although other animal species also may acquire the 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 biggest 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.

Around 250-500 cases (3-6 cases per 100,000 inhabitants) of EHEC infections are reported in Sweden annually, of which around 50% 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 recover fully. 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 and 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 includes those cases that are only positive by PCR where no isolate could be obtained.

SURVEILLANCE

Active surveillance

Animals

If a County Medical Officer suspects an association with a human VTEC 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, approximately 2,000 cattle faecal samples are randomly selected from abattoirs representing about 90% of slaughtered cattle. In the study conducted from 2011-2012, all positive VTEC O157:H7 were also analysed for a subgroup of VTEC O157:H7, called clade 8. This subgroup 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.

Humans

Surveillance in humans is passive.

RESULTS

Animals

Active surveillance

During 2013, five cattle farms and one cattle/sheep farm were investigated as suspected sources for human infection. An epidemiological association was established for one cattle farm with VTEC O157 and one cattle farm with VTEC O26.

Monitoring

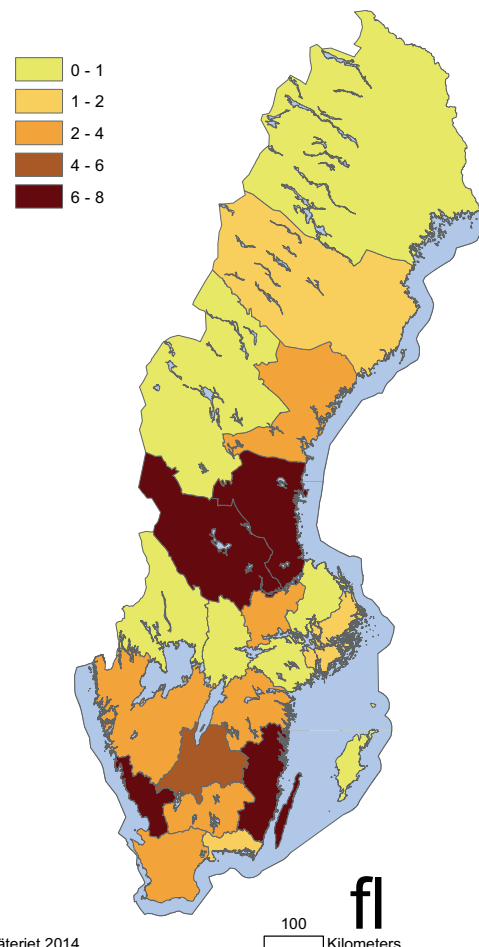
VTEC O157 was detected in nine (1.8%) of 492 faecal and 2 (1.9%) of 105 ear samples from sheep in a survey performed in 2007-2008. In cattle, surveys during 1997-2002 showed a prevalence of approximately 1%. In the study done in 2005-2006, VTEC O157 was detected in 3.4% of faecal samples. In the abattoir survey conducted in 2008-2009 VTEC O157 was detected in 3.3% of 1,993 faecal and 8.2% of 500 ear samples. In the study conducted during 2011-2012, VTEC O157 was detected in 73 of 2,376 faecal samples (3.1%). Clade 8 was detected in 15 of the 73 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, Map 6. The collected samples during 2011-2012 were also analysed for VTEC O26 and VTEC O103. VTEC O26 was detected in 8 of 1308 faecal samples (0.6%) and in 15 of 336 ear samples (4.5%). VTEC O103 was detected in three of 1000 faecal samples (0.3%) and in three of 500 ear samples (0.6%).

Food

During 2013 there were four investigations where food was analyzed due to suspicion of VTEC food poisoning and the suspect food was analyzed at the National Food Agency. In two of these four investi-

Map 6. Geographical distribution of findings of VTEC O157 in cattle at slaughter in 2011-2012.



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gations, a pathogen identical to the VTEC isolated from the human cases, could be detected in food. The implicated food was hamburger and cheese respectively.

Available results from official sampling by local authorities, analyzed by other laboratories than mentioned above, showed that analysis for O157 were done as part of an investigation of food poisoning at five occasions. In one case the result was positive for O157.

Humans

In 2013, 550 human cases were reported, which is the highest number since EHEC became notifiable in 1996. The high number can partly be explained by a number of outbreaks during the year. However, the increasing trend observed during the last couple of years could also be explained by more sensitive laboratory methods and a general increasing awareness of the pathogen, enabling that the analysis for EHEC is requested more frequently.

In 2013, 252 domestic cases were reported (incidence 2.6 cases per 100,000 inhabitants), which is a slight increase compared to 2012 (242 cases). The increasing trend in both total and domestic incidence continued in 2013. However, due to the few

years when comparable data is available (since 2005) statistical significance cannot be calculated. (Figure 18).

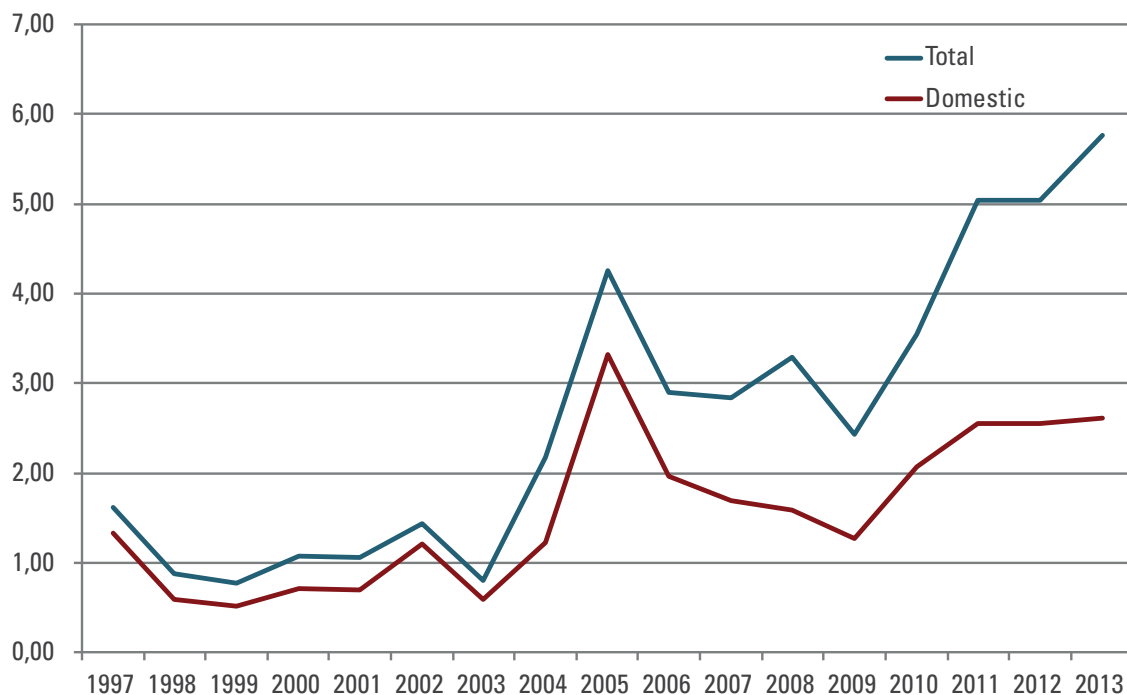
As in previous years, most domestic cases (22%) were in the age group of 1-4 years. EHEC has a seasonal variation with the most cases reported during the summer months. In 2013, 40% of the domestic cases were reported from July to August.

The domestic incidence was highest in Kalmar (7.3 cases per 100,000 inhabitants) followed by Halland (6.8), Dalarna (6.5) and Gävleborg (6.5). 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. The county of Dalarna in the middle of Sweden had 2013 the highest incidence ever reported. The high incidence can be explained by a large outbreak during the summer.

Of the total number human cases, 51% were infected abroad and Turkey was the most common country of infection (n=82) followed by Egypt (44) and Spain (14). Turkey and Egypt are usually the countries outside Sweden where most Swedes become infected with EHEC.

A total of 12 cases of EHEC associated HUS were reported, of which 9 were domestically

Figure 18. Notified incidence(per 100,000 inhabitants) of human VTEC cases in Sweden, 1997-2013



acquired infections. Seven of the HUS cases were in the age group 1-7 years, one was a teenager and four were adults. Three of the domestic HUS cases belonged each to three different outbreaks described below. From eight of the HUS cases, isolates could be obtained and three were O157:H7, two O121, one O111, one O103 and one case with two types, O121 and O157. All cases but one were positive for verotoxin 2. Verotoxin 2 positive isolates are over-represented in the HUS cases. O111 was only positive for verotoxin 1.

In 2013, O157 constituted 36% and non-O157 63% of the domestic cases. O157 was the most common serogroup and of the non-O157, O26 was the most common (17%) followed by O103 (11%), O Non Typable (7%) and O121 and O145 (4% each).

The number of domestic cases with O157 (n=69) is the highest number reported since 2005.

Four outbreaks were reported in 2013 of which one occurred between January and June, affecting five persons from different counties. One of the cases developed HUS. They all had eaten hamburgers produced by the same company and the same rare subtype of O157:H7 could be isolated both from the cases and the hamburgers. The rare subtype had only been seen in two sporadic cases during 2012 and in an outbreak in Denmark the same year, where a high proportion of cases developed HUS. The meat of the hamburgers in the Swedish outbreak could be traced back to six different production plants in four European countries.

In May, seven persons in Bollnäs were infected with the same subtype of O157:H7 and one developed HUS. The suspected source of infection was a cheese made of unpasteurised cow milk from a local farm. Despite extensive local investigation and sampling of the farm, the source could never be confirmed. In July, another two cases with the same subtype were detected. They had not consumed cheese from the farm and the source was never found.

A large outbreak involving 29 cases of EHEC O157:H7 occurred in the county of Dalarna in the end of June. The cases had all visited the same restaurant in Rättvik. They all shared the same subtype of EHEC according to PFGE and MLVA analysis. One case developed HUS. The investigation pointed towards green salad as the common source of infection. The restaurant was closed and sanitised before reopened.

During September and October, a family of ten persons were infected with the same subtype of

O26 of which two were infected with both O26 and O174. The common source was a cheese made of unpasteurised milk bought at a farm in Italy. The same subtype of O26 could be isolated from the cheese and a notification about the farm was sent to the Italian authorities.

DISCUSSION

The prevalence among cattle, based on samples taken at slaughter, has since 2005 been in the range of 3.1-3.4%. 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. 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 former Swedish Institute for Communicable Disease Control, now 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.

In order to reduce the human incidence of EHEC a national five-year strategy plan being developed in co-operation between the Swedish Board of Agriculture, National Food Agency, the former Swedish Institute for Communicable Disease Control now the Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute. One way to reduce the human incidence is to implement control measures to reduce prevalence of human pathogenic VTEC among cattle.

The incidence of EHEC in 2013 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 the last years must be done.

The last years increase in cases reported with EHEC non-O157 was not seen 2013. O157 was the most common serogroup and is largely responsible for the entire increase in serotyped domestic cases in 2013.

Several investigations were performed on sus-

pected connections to farms and food items. Most reported cases from humans are in counties with high cattle-density, eg the southern parts of Sweden. However, the highest screening frequency of EHEC in faecal samples of children with diarrhoea has in a previous investigation been shown to be the highest in the southern parts. Thereby, 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 for this is however not fully investigated. The findings of EHEC in minced meat emphasise the importance of cooking meat properly. Advice concerning this was published at the time of the investigations.

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In order to reduce the human incidence of EHEC, a national five-year strategy plan is being 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. One way to reduce the human incidence is to implement control measures to reduce prevalence of human pathogenic VTEC among cattle.

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Yersiniosis

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 but non-pathogenic strains are common. The most common human pathogenic variant is *Y. enterocolitica* 4/O: 3.

Wild animals, especially rodents and birds are considered the principal reservoir of *Y. pseudotuberculosis*. Both *Y. enterocolitica* and *Y. pseudotuberculosis* are frequently found in pig tonsils and intestinal contents. Infections caused by *Y. enterocolitica* are thought to be food-borne 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. *Yersinia* bacteria are destroyed by heating (pasteurisation and cooking) but are able to grow at refrigerator temperature and can therefore grow in food that is kept cool.

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. Long-time 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

There is no active surveillance in animals.

Food

There is no active surveillance in food.

Humans

The surveillance in humans is passive.

RESULTS

Animals

Y. enterocolitica was identified in two zoo animals and *Y. pseudotuberculosis* from another zoo animal tested positive at the National Veterinary Institute.

Food

In 2013, the local authorities did not report on any samples analysed for *Yersinia*.

Humans

Yersiniosis is mainly a domestic infection. In 2013, 313 cases were reported. Of these, 232 cases (74%) were reported as domestic. Of the 68 cases infected abroad, 17 cases were reported as infected in Spain, eight in Turkey and four in Italy and Thailand respectively, from other countries only a few cases were reported.

During the years 2000-2004, the number of



Photo: Bengt Ekberg, SVA

domestic cases of yersiniosis increased until 2004 when 594 domestic cases were reported (Figure 19). Since 2004, the number of cases has decreased. A trend analysis was performed that included all the domestic cases from 2004-2013 and cases from children younger than one year. All age groups showed a statistical significant downward trend except in the group of children younger than one year for which the downward trend changed in 2011.

In 2013, the majority of the domestic cases were in young children and 28% of them were 0-4 years. Most cases were reported in the summer, during July-August.

DISCUSSION

Yersiniosis is one of the most reported zoonoses in Sweden. Since 2004, the number of reported yersiniosis cases in humans has decreased. 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. Good slaughtering hygiene and good manufacturing practices in food processing are essential for controlling *Yersinia*.

There is a need for more sensitive and selective analytical methods for *Yersinia*. The current ISO standard method will be revised and validated.

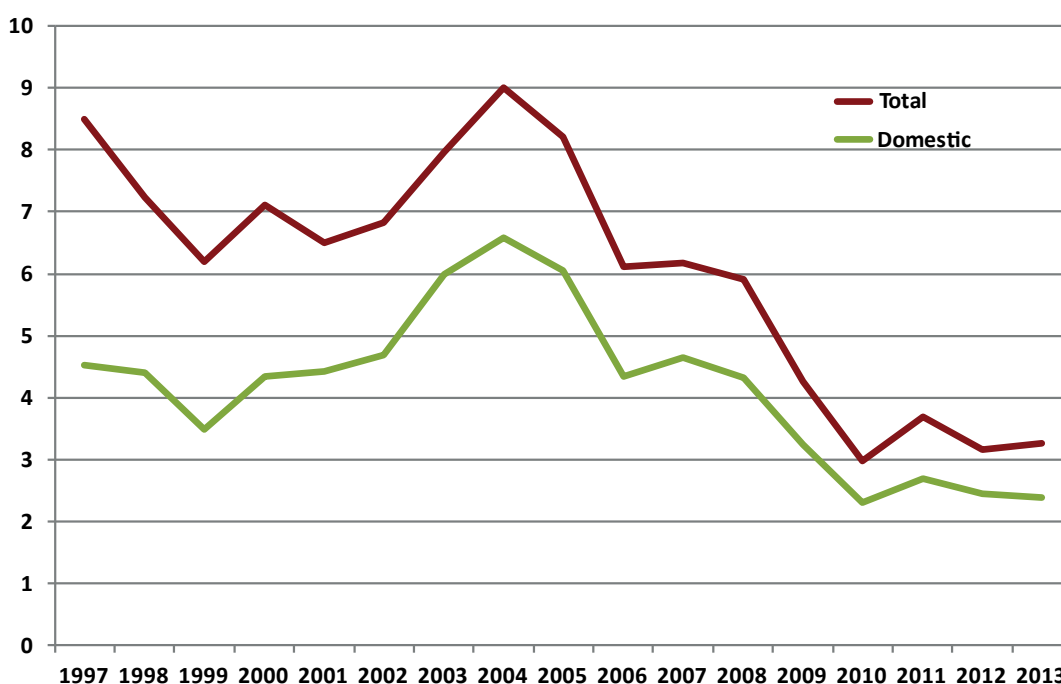
A national 5-year strategy plan for human pathogenic *Y. enterocolitica* has been published in order to identify measures that should be prioritised to decrease human incidence of yersiniosis. The strategy was put together in co-operation between the Swedish Board of Agriculture, National Food Agency,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

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Figure 19. Notified incidence (per 100,000 inhabitants) of human cases of yersiniosis in Sweden, 1997-2013



**Additional
surveillances
2013**

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 outmost 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, it is 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 2012-2013 it was also reported from Ukraine and Belarus, (in the beginning of 2014 sporadic cases were detected in Lithuania and Poland). The risk for further introductions into the 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 dur-

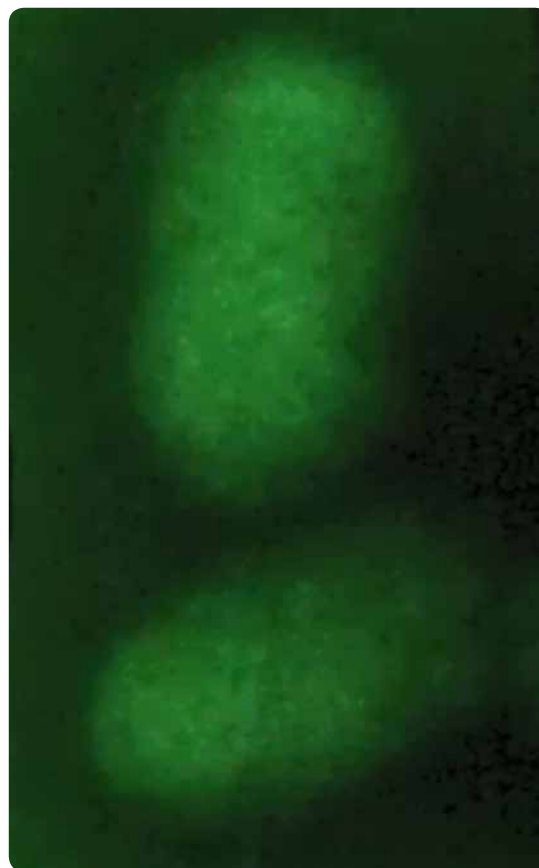


Photo: Åsa Hagström/SVA

Parapox virus, photo taken at the Public Health Agency of Sweden – Folkhälsomyndigheten

ing 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 and wild boar (see also specific chapter on infectious diseases in wild boar) are considered suspicions of ASF until ruled out through further clinical investigation, with or without sampling of affected animals. Due to clinical similarity, samples collected for ASF are also analysed for CSF. This strategy is strongly recommended by the EU.

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

During 2013, 93 suspicions of epizootic diseases were reported and further investigated, including sampling of sick or dead animals (Table 20).

Three clinical suspicions of ASF were investigated. Samples were collected and sent to the National Veterinary Institute for PCR detection and in none ASF could be confirmed (see also the specific chapter on CSF).

Fifteen clinical suspicions of anthrax in cattle, two in horses and one in sheep were investigated, two of which were located in the vaccination zone established after the anthrax outbreak in the county of Örebro in 2011. Within this zone and in its surroundings, farmers and veterinarians were encouraged to notify any sudden death in cattle and other animals as to enhance the passive surveillance of anthrax. All 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. Anthrax was confirmed in one case, in a heifer, which died suddenly on pasture one kilometre from the vaccination zone in Örebro. Whole genome sequencing of the isolated *B. anthracis* demonstrated a close relationship with the isolate that caused the outbreak in 2011. The epidemiological investigation could not conclude the actual source of infection, but carry-over by infected game animals from the vaccination zone

ADDITIONAL SURVEILLANCES 2013

was considered most likely. Spread by water, other cattle or flying insects was ruled out.

Two clinical suspicions of FMD in sheep with lesions in, or around, the mouth and on the udder, were investigated. In both cases Orf (contagious pustular dermatitis) was considered the most likely

diagnosis, but 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. In one of the cases Orf was confirmed, and parapox virus was detected by electron microscopy.

Table 20. Number of suspicions of epizootic diseases reported through the clinical passive surveillance system during 2013 and investigated by experts at the National Veterinary Institute after notification to the Swedish Board of Agriculture.

Disease	Investigated	Confirmed
African swine fever	3	0
Anthrax	18	1
Aujeszky's disease	2	0
Avian influenza	12*	0
Bluetongue	2	0
Brucellosis	5	0
BSE	4	0
Classical swine fever	4	0
FMD	2	0
IBR/IPV	3	0
Newcastle disease	15**	0
Paratuberculosis	4	0
PRRS	9	0
Rabies	8	0
Scrapie (classical and atypical)	1	0
Tuberculosis	8	0
Vesicular stomatitis	1	0
West Nile fever	2	0

* Does not include wild birds found dead

** Includes 12 suspicions in poultry also investigated for AI and described under the specific chapter on AI. In addition, 2 cases of increased mortality in racing pigeons and one in poultry were investigated for ND.

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 are notifiable according to provisions issued by the Swedish Board of Agriculture (SJVFS 2013:23). The diseases included in the programme during 2013 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* and *Mycoplasma meleagridis* are important poultry pathogens. However, *M. meleagridis* is only pathogenic for turkeys. These two mycoplasmas are able to spread both horizontally and vertically. They mainly cause respiratory disease and egg production losses. *Mycoplasma gallisepticum* may also cause arthritis and is 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).
- 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, eleven 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 water fowl (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.

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 2012, seven different breeding companies participated in the pro-

gramme; 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 21 and 22.

RESULTS

Table 23 gives an overview of all samples taken in breeding flocks of chickens and turkeys, and the laboratory methods used, during 2013. All analysed samples tested negative for *Salmonella Gallinarum*, *Salmonella Pullorum*, *Mycoplasma gallisepticum* and *Mycoplasma meleagridis*.

In June 2013, antibodies to avian paramyxovirus type 1 were detected in a flock of parent broiler hens. No clinical signs suggesting an outbreak of Newcastle disease were observed in the flock and the egg

production was unaffected. In subsequent investigations, PMV-1 was detected by PCR from swabs and sequencing showed that the virus was a lentogenic APMV-1. However, several attempts to isolate the virus from swabs and organs were unsuccessful. During 2013, 15 chicken flocks (three grandparent and 12 parent flocks) were further investigated due to a few positive samples for egg drop syndrome. 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.

The detection of antibodies to APMV-1 in a flock of parent broiler hens within the programme in 2013 showed the importance of the poultry health

Table 21. 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
S. Pullorum/ S. Gallinarum		60			
<i>Mycoplasma gallisepticum</i>	60	60	60	60	60
Paramyxovirus type 1				60	
Egg drop syndrome-virus		30			

Table 22. Sampling schedule for turkey parent flocks. Number of blood samples tested at different weeks of age.

Agent \ Age in weeks	20	32	44	56
S. Pullorum/ S. Gallinarum		60		
<i>Mycoplasma gallisepticum</i>	60	60	60	60
<i>Mycoplasma meleagridis</i>	60	60	60	60
Paramyxovirus type 1				60

control programme to detect subclinical infections. Since this infection interfered with the serological surveillance and also since it has been shown that mild PMV-1 may gain virulence through a few point mutations, it was considered necessary to map and monitor the distribution of the infection. For this, the serum bank at the National Veterinary Institute which contains sera from previous sampling occasions within the programme, proved to be of utmost importance as the introduction of the infection could be traced to one flock in the beginning of 2013. In addition, to monitor the situation, extra

PMV-1 analyses were performed at the ordinary sampling occasions within the programme during the autumn and winter 2013 – 2014. All serologically positive flocks are now (April 2014) slaughtered and the surveillance is back to normal.

In conclusion, the results from the serological screening in the Poultry Health Control Programme in 2013 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 23. Number of sampling occasions for grandparent (GP) and parent (P) flocks of chickens and turkeys and total number of samples tested during 2013.

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>	8	69	4	480	4,140	240	Serum plate agglutination test
<i>Mycoplasma gallisepticum</i>	44	348	16	2,640	20,880	960	ELISA MG antibody test, ID.Vet
<i>Mycoplasma meleagridis</i>	0	0	16	0	0	960	Serum plate agglutination test
Paramyxovirus type 1	8	64	4	480	3,840	240	NDV screen competition ELISA, ID.Vet
Egg drop Syndrome-virus	8	69	0	240	2,070	0	Antibody haemagglutination inhibition 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) in Russia and other countries in Eastern Europe 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 175,000 animals before the reproductive season of 2014. The northern border of the wild boar habitat is extending north and is at present at 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 a passive surveillance for the disease in wild boars found dead has been added to the surveillance programme during 2013.

LEGISLATION

The infections investigated in the wild boar surveillance programme of 2013 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 analysis irrespective of pathological lesions.

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 based on 500 samples from an infinite population. The samples were analysed using the serological methods described under the respective disease headings in this report.

RESULTS

Passive surveillance

Fourteen wild boars found dead were examined for African swine fever virus and all analyses were negative. They were found predominantly in south-east Sweden (Map 7 dots). Additional post mortem findings in these wild boars are reported under the heading "Post mortem examinations in wildlife" in this report.

Active surveillance

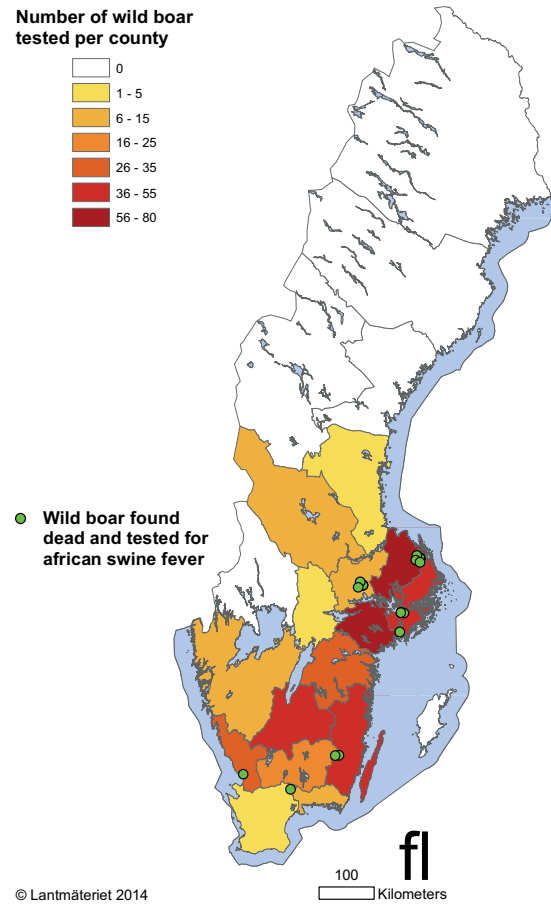
In 2013, 411 samples were collected from shot wild boars. The geographical distribution of sampled wild boars was roughly correlated to the distribution and density of the Swedish wild boar population (Map 7). All analyses for Aujeszky's disease and classical swine fever were negative. Two samples were 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 both samples were "singleton reactors" and not caused by true infection with porcine reproductive and respiratory syndrome virus.

The sensitivity of the active surveillance was lowered to about 98% due to the fact that the goal of 500 samples was not fully 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 2013 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 and Eastern Europe is of special concern and calls for reliable methods for early detection of disease in the wild boar population.

Map 7. Geographical distribution of wild boar sampled in 2013.



Infectious diseases in fish, crustaceans and molluscs

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 hydroelectric 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 sampling and diagnostics 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). In addition, samplings and diagnostics are routinely done for Koi herpes virus (KHV), Crayfish plague in Crayfish and Bonamio-

sis and Marteilirosis 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 rhabdovirus 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 up to 80%. In rainbow trout, the disease is chronic with a continuous low mortality of about 5-10%. 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 sub-clinical carriers.

The 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 crayfish populations. Disease in the individual is characterised 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 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 the Swedish populations of crustaceans.

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.

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 clas-

sification 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 great opportunity 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 or by cultivation and verification 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.

RESULTS

Official health programme for fish farmers, crustacean and mollusc surveillance

The number of samples analyzed and results are shown in Table 24. In summary, the active surveillance detected (one case=one outbreak):

- 1 case of IPNab in rainbow trout, coastal zone
- 1 case of BKD in arctic char, inland zone
- 1 case of KHV in imported Koi
- 4 cases of Crayfish plague
- 2 cases of Marteiliosis, one in farmed blue mussels, one in a wild blue mussel population, both on the west coast

Voluntary health programme for fish farmers

There were three recorded outbreaks of other notifiable diseases in fish during 2013; three cases of ASS – two on inland farms and one on a farm in the coastal zone, and one case of ERM on an inland farm.

DISCUSSION

The number of farms that were sampled for the viruses listed in Table 24 and BKD was in line with expectations. Sweden has a high health aquaculture, 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 need of killing the fish to an in vivo method. The presence of BKD and furunculosis in inland farms is a cause for concern. Presently, it is not clear if its appearance is just coincidence or if the health control or farmers awareness of biosecurity has started to deteriorate. Additional resources must be invested in the risk-based analysis of individual aquaculture farms to get a more reliable assessment for health surveillance. Marteiliosis was previously identified in Sweden, in another farming site within the same company that had infected mussels this year. The present site is within the containment zone still in place from the first case, whereas the case in wild mussels was further out in the west coast archipelago. 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 inter-

est in farming this species. Fish farms importing roe or live fish also poses 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 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.

Table 24. 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	92			485	-/0
IHN	92			485	-/0
IPN	92	1		485	-/1d
SVC	5			16	-/0
KHV	4	1	12	30	1/0
BKD	68	1	2,910	-	7e/-
Crustaceans					
<i>Aphanomyces astaci</i>	10	4		45	9/-
WSSv	1			17	0/-
Molluscs					
<i>Bonamia ostreae</i>	5a	0	150		0/-
<i>Marteilia refringens</i>	10b	2c	300		13/-

a 1 oyster farm, 4 wild oyster populations

b 3 blue mussel farms, 2 blue mussel wild populations, 1 oyster farm, 4 wild oyster populations

c 1 blue mussel farm, 1 wild blue mussel population

d source tracking revealed that another nearby production site within the same company was also infected (4 positive pools)

e By ELISA, verified with PCR that was positive in 2 of 7 fish

Post mortem examinations in food producing animals

BACKGROUND

Early detection of infectious diseases is of outmost 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 and the Swedish Animal Health Service is responsible for the organisation.

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 addition to post mortem examinations, samples are 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 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 2013 post mortem examinations were performed at five different sites throughout the southern part of the country; Skara (Eurofins Food & Agro), Kristianstad (Eurofins Food & Agro), Upp-

sala (the National Veterinary Institute and the University of Agriculture), Visby (Animal Health Service) and Karlskoga (Animal Health Service in cooperation with the field veterinary organisation of the Swedish Board of Agriculture, and Konvex). Large animals, such as adult cattle, were examined at four of these sites, Uppsala, Kristianstad, Karlskoga and Visby. A total of 3331 post mortem examinations were performed within the programme during 2013. The distribution, species and the region of origin are shown in Map 8.

In 2013, 102 cases were diagnosed as a notifiable disease at post-mortem examination. Table 25 shows the reported primary cases of notifiable diseases detected at post mortem examination.

DISCUSSION

The post-mortem examinations are a vital part of the national surveillance for infectious and emerging diseases, as illustrated by the detection of 102 index cases of notifiable disease in 2013. Post mortem examination is also an important tool for the individual farmer to solve animal health problems at the farm. In the last decade the number of post mortem examinations has been around 3,000 per year.

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 transportations 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, will be initiated during 2014.

Table 25. Number of index cases of a notifiable disease 2011–2013, diagnosed from samples taken at post mortem examination.

Disease	2011	2012	2013
Anthrax	1	0	0
Avian rhinotracheitis			1
Avian tuberculosis (poultry)	2	1*	-
Blackleg	7	8	7
Bovine Malignant Catarrhal fever	0	1	3
Fowl Cholera (pasturellosis)	2	0	0
Fowl typhoid (<i>S. Gallinarum</i>)	0	1	0
Infectious Bronchitis	2	4	0
Infectious laryngotracheitis	16	17	36
Influenza, pigs	0	3	1
Influenza A typ (H1N1) 2009			3
Listeriosis	35	38	49
Lymphoma (not EBL)*	7	11	-
Mycoplasma gallisepticum	0	3	0
Mycoplasma, poultry, not gallisepticum*	2	3	-
Necrotic haemorrhagic enteritis (<i>Clostridium perfringens</i> type C)	0	1	0
Salmonellosis	4	3	2
Total	78	94	102

Statistics from Swedish Animal Health Services.

*) this disease is longer notifiable since November 2012, thus one case previously reported was removed from 2012 accordingly.

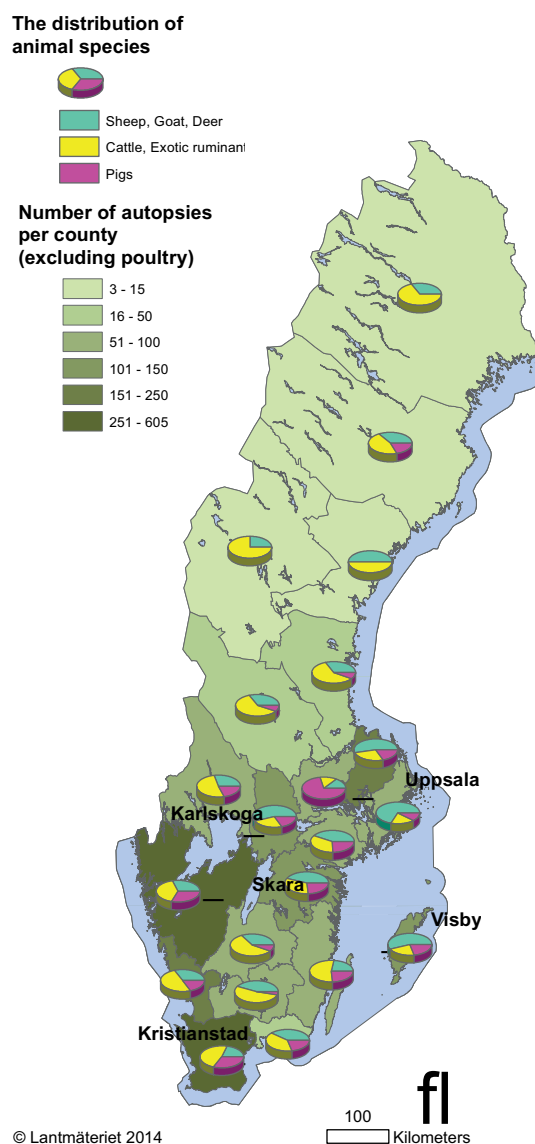
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Redovisning av uppdrag om veterinär obduktionsverksamhet. veterinär obduktionsverksamhet (SJV Dnr 33-10225/10)

Personal communication, Jenny Lundström Swedish Animal Health Service.

Map 8. Number of autopsies per county (excluding poultry)



Examination of abortions in food producing animals

BACKGROUND

Post mortem 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 changes 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 post mortem examination programme. During the last part of 2012 and the first months of 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 (and, for a part of the year, for SBV). All diagnostic testing was performed at the National Veterinary Institute. The foetuses were analysed for the CSFV, PRRS and SBV 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. (See Table 26) The numbers for the last two years have been extraordinary high, most likely because of increased attention due to the newly identified infection with Schmallenberg virus(SBV).

DISCUSSION

The post-mortem 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 from late November 2012 until June 2013. During that time, 33 lambs and 27 calves infected with SBV was detected. Testing for SBV ended in 2013 because the disease, at that time, had become established in Sweden and therefore was considered endemic.

Table 26. Number of examined foetuses in the surveillance since start 2008

Species	2008	2009	2010	2011	2012	2013
Cattle	14	15	62	21	63	114
Goat	0	0	9	3	5	4
Sheep	0	29	70	45	79	89
Alpaca	0	2	5	0	0	4
Bison	0	0	0	0	1	1
Gnu	0	0	0	0	0	1
Visent	1	1	0	2	1	0
Pig	37	79	61	51	54	46
Total	52	126	207	122	203 (132)	259 (179)

Post mortem examinations in wildlife



Photo: SVA

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 the wildlife management research fund that uses part of the compulsory annual hunting permit fee for Swedish hunters, and partly by governmental funding for biodiversity, managed by the Environmental Protection Agency. The funding pays for staff running the programme, for transports and examinations of fallen wildlife, as well as dissemination and publication of results. An active wildlife disease surveillance programme was established in 2006 in order to fund or support spe-

cific pilot studies or other relevant studies that can diagnose, define, or acquire knowledge on present and emerging diseases in Swedish wildlife.

SURVEILLANCE

The general public, local authorities and hunters can submit wildlife that is found dead or found sick and then euthanized, to the National Veterinary Institute for examination. The aim of the passive and active wildlife disease surveillance programmes is to monitor the health status of wildlife in Sweden. Whenever possible, disease causing agents are identified. 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 diseases, as well as a specific selection of diagnosed non-listed wildlife diseases.

RESULTS

In 2013, almost 2,200 wild animal samples were submitted to the Department of Pathology and Wildlife Diseases. This includes fallen wildlife, parts of fallen wildlife, lesions found in game animals, and standard samples collected from hunted large carnivores or other hunted game species. Hunter harvested wild boar samples for *Trichinella* analysis are not included in these numbers. All dead large carnivores including: lynx (*Lynx lynx*), brown bears (*Ursus arctos*), wolf (*Canis lupus*) and wolverine (*Gulo gulo*) are autopsied at the pathology department. Samples from these species may also be submitted when hunted or euthanized as problem animals. Licensed hunting of lynx and brown bear was done in 2013. There were 748 birds or samples from birds examined, including 146 eagles, which are systematically sent to the Institute together with other listed protected species.

In 2013, 133 outbreaks of OIE non-listed wildlife diseases were reported, with verified cases in single or multiple animals submitted for diagnostics. The most common findings were sarcoptic mange in carnivores and wild boar, salmonellosis in passerines and hedgehogs, *Trichomonas* infections in passerines, and an unusual high number of *Trichinella* findings in brown bears (Table 27). The surveillance of the fox dwarf tapeworm *Echinococcus multilocularis* continues after the finding of the parasite in Sweden in 2011. In 2012-2013, a nation-wide screening of scats from foxes was initiated. A network of hunters collected and submitted scats for PCR analysis. A more focused local screening of hunted foxes around the three known sites of *Echinococcus* infection in Sweden was done to follow up the local prevalence and geographic spread of the parasite in these areas.

DISCUSSION

The submitted and examined cases and samples indicate that the presence of serious contagious wildlife diseases in Sweden remains low. The passive and active wildlife surveillance efforts, together with the monitoring of reports from the public, other authorities, international forums both in human and digital networks and wildlife disease related associations form a well established toolbox used to identify new or threatening emerging wildlife diseases, as well as monitoring endemic diseases. The introduction of new diseases can be expected to continue both with migrating animals and due to the high risk factors such as human transportation, travel and interference.

Table 27. OIE non-listed wildlife diseases and number of outbreaks/cases reported to the OIE for 2013.

Disease	Species	Latin name	Outbreaks
Avian tuberculosis	Eurasian eagle-owl	<i>Bubo bubo</i>	1
Elaphostrongylus	Moose	<i>Alces alces</i>	1
Paramyxovirus PMV-1	Feral pigeon	<i>Columbia livia</i>	6
Pasteurellosis	Fallow deer	<i>Dama dama</i>	6
Rabbit viral hemorrhagic disease	Rabbit	<i>Oryctolagus cuniculi</i>	3
Salmonellosis	Passerines	<i>Several sp.</i>	15
Salmonellosis	Gulls	<i>Laridae</i>	2
Salmonellosis	White-tailed eagle	<i>Haliaeetus albicilla</i>	1
Salmonellosis	Great grey owl	<i>Strix nebulosa</i>	1
Salmonellosis	Common buzzard	<i>Buteo buteo</i>	1
Salmonellosis	Great spotted woodpecker	<i>Dendrocopus major</i>	2
Salmonellosis	White-backed woodpecker	<i>Dendrocopus leucotus</i>	1
Salmonellosis	Grey-headed woodpecker	<i>Picus canus</i>	1
Salmonellosis	European hedgehog	<i>Erinaceus europaeus</i>	15
Salmonellosis	Roedeer	<i>Capreolus capreolus</i>	1
Salmonellosis	Brown bear	<i>Ursus arctos</i>	1
Salmonellosis	Red fox	<i>Vulpes vulpes</i>	5
Salmonellosis	Lynx	<i>Lynx lynx</i>	1
Salmonellosis	Moose	<i>Alces alces</i>	1
Sarcoptic mange	Lynx	<i>Lynx lynx</i>	18
Sarcoptic mange	Red fox	<i>Vulpes vulpes</i>	3
Sarcoptic mange	Wolf	<i>Canis lupus</i>	6
Sarcoptic mange	Wild boar	<i>Sus scrofa</i>	6
Sarcoptic mange	Arctic fox	<i>Vulpes lagopus</i>	3
Trichinosis	Red fox	<i>Vulpes vulpes</i>	5
Trichinosis	Lynx	<i>Lynx lynx</i>	1
Trichinosis	Wolf	<i>Canis lupus</i>	2
Trichinosis	Brown bear	<i>Ursus arctos</i>	5
Trichinosis	Wild boar	<i>Sus scrofa</i>	3
Trichinosis	Wolverine	<i>Gulo gulo</i>	3
Trichomonas	Yellowhammer	<i>Emberiza citrinella</i>	1
Trichomonas	Green finch	<i>Chloris chloris</i>	14
Trichomonas	Great tit	<i>Parus major</i>	1
Tularemia	European brown hare	<i>Lepus europaeus</i>	11
Tularemia	Mountain hare	<i>Lepus timidus</i>	1

Antimicrobial resistance in bacteria from animals and food

BACKGROUND

The National Veterinary Institute 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. This is carried out in the Swedish Veterinary Antimicrobial 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 antimicrobials in animals. Details on methodology used are available in the 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 of use of antimicrobials in an animal population. Moreover, these commensal bacteria can 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 bacteria from farm animals and meat given in the zoonosis directive (2003/99/EG) and subsequent decisions (2013/653/EU). According to the directive, resistance in *Salmonella*, *Campylobacter* and in indicator bacteria shall be regularly monitored using harmonised methodology. Briefly, in Sweden this implies that each year, isolates of *Salmonella* from all notified incidents are susceptibility tested. Also, yearly, about 100 isolates of *Campylobacter* from broilers, pigs or calves are tested. In addition, 200 samples of intestinal content collected at slaughter from healthy broilers, pigs or calves are cultured for *E. coli* and enterococci are tested for antimicrobial susceptibility annually. These latter samples are also screened for ESBL resistant *E. coli*. At irregular intervals, samples of meat from broilers or pigs are cultured for *E. coli* and enterococci, and are subse-

quently tested for susceptibility. The meat samples are also screened for ESBL resistant *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 the National Veterinary Institute. SVARM is also complemented with data from research projects and specifically from the SVARMPat project focusing on resistance in animal pathogens from farmed animals. SVARMPat is run in cooperation with Swedish Animal Health Service and is financed by the Board of Agriculture.

Results of SVARM, i.e. data on antimicrobial resistance in bacteria from animals and food are presented in a yearly report together with data on sales of antimicrobials 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 2013

Overall the Swedish situation regarding antimicrobial resistance in bacteria from humans and animals is still favourable when seen in an international perspective. This confirms that the Swedish strategies to promote rational use and to contain antimicrobial resistance in bacteria from animals and humans are effective.

Antibiotic use in veterinary medicine

Following a change in the regulation of the Swedish pharmacy market, concerns have been raised about lack of completeness of sales data from pharmacies. Most likely, this problem primarily affects sales of injectable drugs. The National Veterinary Institute has estimated the lack of completeness to 5-10% of the total sales. Expressed as mg per 'population correction unit' (PCU), the sales in 2012 were 14 mg/PCU. This is 25% lower than in 2009. Thus, even if the lack of completeness is taken into account there is a decrease in sales over time.

Resistance as notifiable disease

Extended spectrum beta-lactamase (ESBL) producing Enterobacteriaceae

The available data indicate that ESBL-producing bacteria are rare in animals in Sweden. An exception is poultry where *Escherichia coli* producing CMY-2 (ESBLM) is found in intestinal content in a large proportion of birds. However, transmission of such bacteria to humans seems uncommon as this type of ESBL resistance is uncommon in isolates from humans.

Methicillin resistant Staphylococcus aureus (MRSA)

Findings of MRSA in animals are notifiable to the Board of Agriculture. MRSA is rare among animals in Sweden and in 2013, one case in a dairy cow, one in a horse, five in dogs and one case in a cat were notified. The types of MRSA found in dogs and cats have been of the same as those that occur in humans and most likely the route of transmission have been from humans to animals. Prevalence of MRSA among horses and farm animals is low and these animals are currently not an important reservoir for human infection.

Methicillin resistant Staphylococcus pseudintermedius (MRSP)

Findings of MRSP in animals are notifiable to the Board of Agriculture. Since 2009, an apparent decline in notified cases of MRSP is noted and in 2013 only 33 cases of MRSP in dogs and cats were reported. The zoonotic potential of MRSP is low and only sporadic human cases have been reported.

Vancomycin resistant enterococci (VRE)

Previous data from SVARM show that *E. faecium* with the vanA gene are present among Swedish broilers. The majority of VRE in humans are of the vanB genotype and transfer from Swedish broilers therefore seems unlikely.

Resistance in zoonotic pathogens

Salmonella is rare in animals in Sweden and few incidents involve multiresistant strains. ESBL-resistance has not been found and resistance to fluoroquinolones is rare. The favorable situation makes animals in Sweden an unlikely source of resistant *Salmonellae* infecting humans.

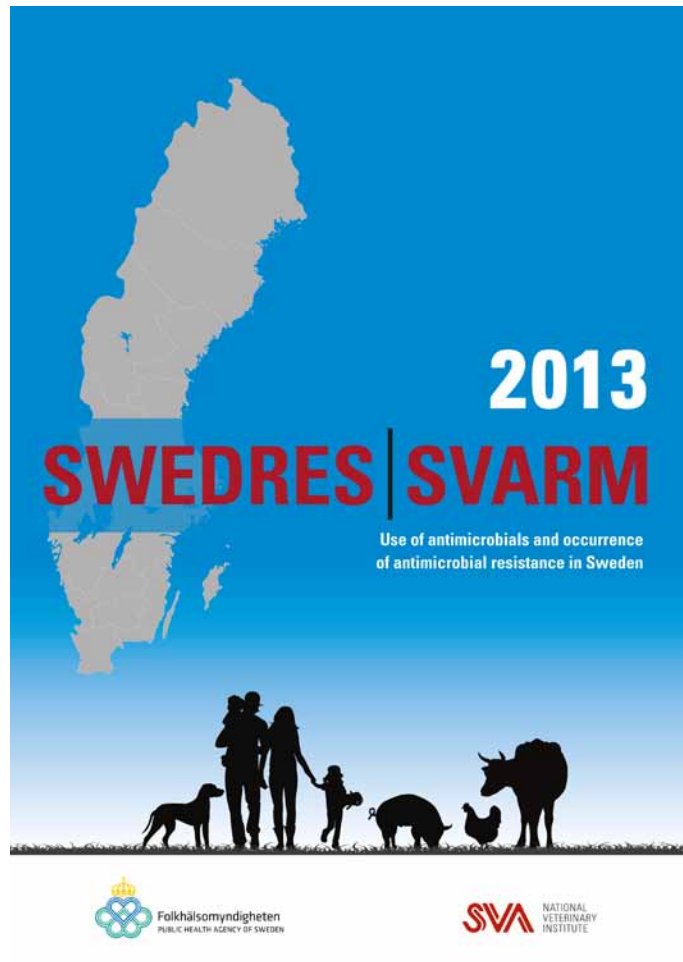
Campylobacter from animals in Sweden are mostly susceptible and, for example, resistance to erythromycin is uncommon. Quinolone resistance is however common in *C. jejuni* from broilers and calves and in *C. coli* from pigs. Nevertheless, animals in Sweden are an unlikely source for *Campylobacter* with the high resistance levels found in isolates from humans.

Resistance in animal clinical isolates

Bacteria causing clinical disease in animals are mostly susceptible to relevant antimicrobials. Respiratory pathogens from farm animals and horses are generally susceptible to benzylpenicillin. Penicillin resistance is common in *Staphylococcus pseudintermedius* from dogs and occurs in *Staphylococcus aureus* from horses. Resistance in *Escherichia coli* occurs in all animals but is most prominent in enteric isolates from young calves. Susceptibility testing to guide antimicrobial therapy is especially warranted for staphylococci and *Escherichia coli*.

Resistance in indicator bacteria from healthy animals

Resistance in *Escherichia coli*, *Enterococcus faecalis* and *Enterococcus faecium* from the enteric flora of healthy animals indicates the prevalence of acquired resistance in an animal population and indirectly the magnitude of antimicrobial use. These bacteria are unlikely to cause disease but they can be reservoirs for resistance genes that can spread to bacteria that cause infections in animals or humans. Prevalence of resistance in indicator bacteria from Swedish animals is low and the situation is favorable in an international perspective.



Download the report at www.folkhalsomyndigheten.se or at www.sva.se



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