

# SURVEILLANCE OF INFECTIOUS DISEASES IN ANIMALS AND HUMANS IN SWEDEN 2014



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**Layout:** The production of this report was accomplished using a primarily open-source toolset to build a report generating process. This allowed the source text, produced by authors, to be edited independently of the template for the layout which can be modified and reused for future reports. Specifically, the chapter texts were authored in Microsoft Word and then converted using LibreOffice and pandoc to the LaTeX typesetting language and then compiled to PDF using LuaTeX in MikTeX. All figures and maps were produced using R software for statistical computing. The code for the project was managed using the git version control system and GitLab project management software. Other open-source tools used in this production process included but were not limited to: Make, emacs and Linux. The technical design of the report generating process was by Thomas Rosendal, Stefan Widgren and Rickard Wolrath. Design of the layout by Helena Ohlsson.

**Print:** TMG Tabergs AB.

Printing and part of the production was financed by the Swedish Board of Agriculture. Text, tables, figures and maps may be cited and reprinted only with reference to this report.

**Suggestion citation:** Surveillance of infectious diseases in animals and humans in Sweden 2014, National Veterinary Institute (SVA), Uppsala, Sweden. SVA:s rapportserie 31 ISSN 1654-7098.

This report is available at [www.sva.se](http://www.sva.se). Reprints can be ordered from Department of Disease Control and Epidemiology, National Veterinary Institute, SE-751 89 Uppsala, Sweden. Phone +46(0) 18 67 40 00. E-mail: [sva@sva.se](mailto:sva@sva.se).

# Contents

Introduction	5	Maedi-visna	56
Livestock population and trade in live animals	6	Nephropathia epidemica	58
Animal databases	9	Paratuberculosis	60
Institutions, organisations and laboratories involved in monitoring	10	Porcine reproductive and respiratory syndrome	63
Disease Surveillance 2014	13	Psittacosis	66
Atrophic rhinitis	14	Q fever	68
Aujeszky's disease	15	Rabies	70
Bluetongue	17	Salmonellosis	72
Bovine spongiform encephalopathy	19	Swine vesicular disease	85
Bovine viral diarrhoea	21	Scrapie	86
Brucellosis	23	Tick-borne encephalitis	88
Campylobacteriosis	26	Transmissible gastroenteritis	90
Classical swine fever	30	Trichinellosis	92
Coccidiosis and clostridiosis	32	Tuberculosis	94
Echinococcosis	33	Tularaemia	97
Alveolar echinococcosis	33	Verotoxinogenic Escherichia coli	99
Cystic echinococcosis	37	Yersiniosis	103
Enzootic bovine leucosis	38	Additional Surveillance 2014	105
Footrot	39	Clinical passive surveillance	106
Infectious bovine rhinotracheitis	41	Poultry Health Control Programme	109
Influenza	43	Infectious diseases in wild boars	112
Avian Influenza	43	Infectious diseases in fish, crustaceans and molluscs	114
Swine influenza	47	Examination of abortions in food producing animals	118
Leptospirosis	51	Post mortem examinations in food producing animals	119
Listeriosis	53	Post mortem examinations in wildlife	123
		Antimicrobial resistance in bacteria from animals and food	125



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# Introduction

**Surveillance of infectious diseases in animals and humans 2014**, is the annual update on the surveillance activities carried out in Sweden during the year, for animal diseases and zoonotic agents in humans, food, feed and animals. Comprehensive animal disease surveillance is an important step in declaring the good health and animal welfare status of Sweden. The maintenance of these surveillance initiatives for serious infectious diseases, within the One Health perspective is not without cost. Resources are required to organize, select and sample diagnostic data from different groups in a representative way, and sustain the use of accurate modern diagnostics. Both human and veterinary epidemiologists struggle with the 'good health status paradox' which means that it can be difficult to motivate the allocation of funding to surveillance efforts when the disease burden is low. However, if investment in knowledge of the disease state is not prioritized the excellent health status of the Swedish animal population can easily be lost.

In order to improve existing surveillance, a national strategy for animal surveillance has been developed and presented to the Swedish Board of Agriculture (SBA). It is a tool for prioritizing surveillance programmes and will gradually be implemented during 2015. The aim is to identify short and longterm objectives, as well as, establish the needs for animal health surveillance. In addition, strategic documents for important zoonoses such as *Salmonella*, *Campylobacter*, *Listeria*, *Yersinia*, *Cryptosporidium* and Verotoxigenic *Escherichia coli* (VTEC) have been produced in collaboration with the SBA, the National Food Agency, the Public Health Agency of Sweden and the National Board of Health and Welfare. 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.

The success of the focus on surveillance and control of animal disease was reinforced during 2014, when Sweden was declared free from bovine viral diarrhoea. The eradication scheme started in 1993, as a voluntary programme and was made compulsory in 2001. The freedom from this economically important disease is an endowment for future cattle production in Sweden.

Surveillance initiatives must be regularly evaluated and allowed to evolve to incorporate new diagnostic methods and new knowledge of the disease. The prevalence of *Salmonella* in food producing animals is, like in Finland and Norway, very low. This is illustrated by the low numbers of human cases of salmonellosis caused by domestic food. The surveillance for *Salmonella* in Swedish cattle is mainly passive, and not all infected herds are identified. This was shown by a bulk milk survey in 2013 where antibodies to *Salmonella* were detected in some herds. After these findings, the SBA examined changes to improve the surveillance and control of *Salmonella* in cattle. The proposed new strategy would augment existing surveillance with regular national bulk milk surveillance of dairy herds and serological surveillance in beef herds, combined with bacteriological examination.

The evolving situation of African Swine Fever (ASF) and avian influenza in our neighbouring countries, and internationally, is a challenge since it is impossible to anticipate which of the many potential routes will result in disease introduction. Good knowledge and awareness in the field, along with a well structured passive surveillance system are vital to prevent the introduction and establishment of serious infectious transboundary diseases from outside of Sweden.

# 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 slaughter figures cover the year 2014. Figures 1, 2, 3 and 4 give an overview of the livestock population in Sweden. The data for aquaculture covers 2013.

## CATTLE

There are 18,210 holdings with a total number of 1,493,200 cattle (dairy cows, cows for calf production, heifers, bulls, steers and calves younger than one year) in Sweden (Figure 2).

The number of dairy cows has decreased over a long period of time. However, a slight increase was noted from June 2013 to June 2014. There were 344,000 cows in 4,400 dairy herds with an average of 78 cows per herd. The number of cows for calf production was 186,260 in June 2014 with an average herd size of 17 cows.

In total, approximately 406,000 adult cattle and 25,000 calves were slaughtered during 2014.

## PIGS

The total number of pigs was 1,377,530 (Figure 3) in June 2014, which is an increase compared to 2012. However, since 1995 the number of pigs has reduced by 40% and during the past 11 years two out of three holdings have closed down.

About 2,566,000 pigs were slaughtered during 2014.

## SHEEP

In June 2014, there were 8,951 sheep holdings with a total of 287,303 ewes and rams (Figure 4). Sheep holdings in Sweden are usually small-scale enterprises with an average herd size of 32 adult sheep. During 2014, approximately 258,000 sheep were slaughtered of which 223,000 were lambs.

## GOATS

In 2014 the reported number of goats and goat holders in Sweden were 11,595 and 1,396 respectively.

## POULTRY

The number of fowl has increased continuously the last two decades, except for the last year. In 2014 there were 6.5 million hens (chicken not included) in 3,878 holdings.

Eggs delivered to wholesalers amounted 99.7 million kilos during 2014.

The number of holdings in June 2014 with broiler production was 260 and about 88 million chickens were sent for slaughter during the year. During 2014 420,000 turkeys were slaughtered, a decrease compared to last two years.

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

## FISH AND SHELLFISH

Rainbow trout are the most frequently farmed fish followed by char, salmon and brown trout; salmon and brown trout are mainly for restocking of feral populations. Of the shell fish production, blue mussel has the highest tonnage, while oysters and crayfish are more limited.

The production in 2013 was 9,888 metric tonnes of food fish, which when converted to round fresh weight is the equivalent of 11 663 tonnes. Rainbow trout dominated, with 84 % of the total production of fish for consumption.

The production for stocking is dominated by rainbow trout as well. The total production of fish for restocking was estimated at 1,016 tonnes.

To compensate for natural reproduction, that has been lost due to hydroelectric power plants, 2.8 million of fry of salmon and sea trout were released, mainly in rivers running into the Baltic sea.

## TRADE IN LIVE ANIMALS

In 2014, 152 pigs were brought in to Sweden from Norway. 23 cattle came from Denmark and 5 water buffaloes from Germany, 14 sheep from Germany, 248,000 day-old chicks from Great Britain, Germany and France and 7,737 day-old

turkey chicks from Great Britain.

The number of animals leaving the country during 2014 were 90 cattle, 48 sheep, 36,858 pigs of which 35,215 were sent for slaughter in Germany. Altogether 3,405,000 day-old chicks were sent to Denmark, Estonia, Lithuania, Poland, Germany, Latvia and Finland, About 1, 3 million live fowls (*gallus domensticus*)were sent to Germany, Denmark and Finland, 5,300 ducks were sent to Finland and 4 geese to Norway.

**REFERENCES**

TRACES (**TR**AdE **C**ontrol and **E**xpert **S**ystem) is a trans-European network, developed by EU COM, for veterinary health which notifies, cer-

tifies and monitors imports, exports and trade in animals and animal products.

Jordbruksverkets statistikdatabas (available at: <http://statistik.sjv.se/PXWeb/pxweb/sv/Jordbruksverkets%20statistikdatabas/?rxid=5adf4929-f548-4f27-9bc9-78e127837625>)

Aquaculture in Sweden in 2013, JO60SM1401, Swedish Board of Agriculture

Animal products - Annual and monthly statistics -- 2014:12, JO 48SM1502, Swedish Board of Agriculture

Surveillance of infectious diseases in animals and humans in Sweden 2013, SVA.s rapportserie 26 ISSN 1654-7098

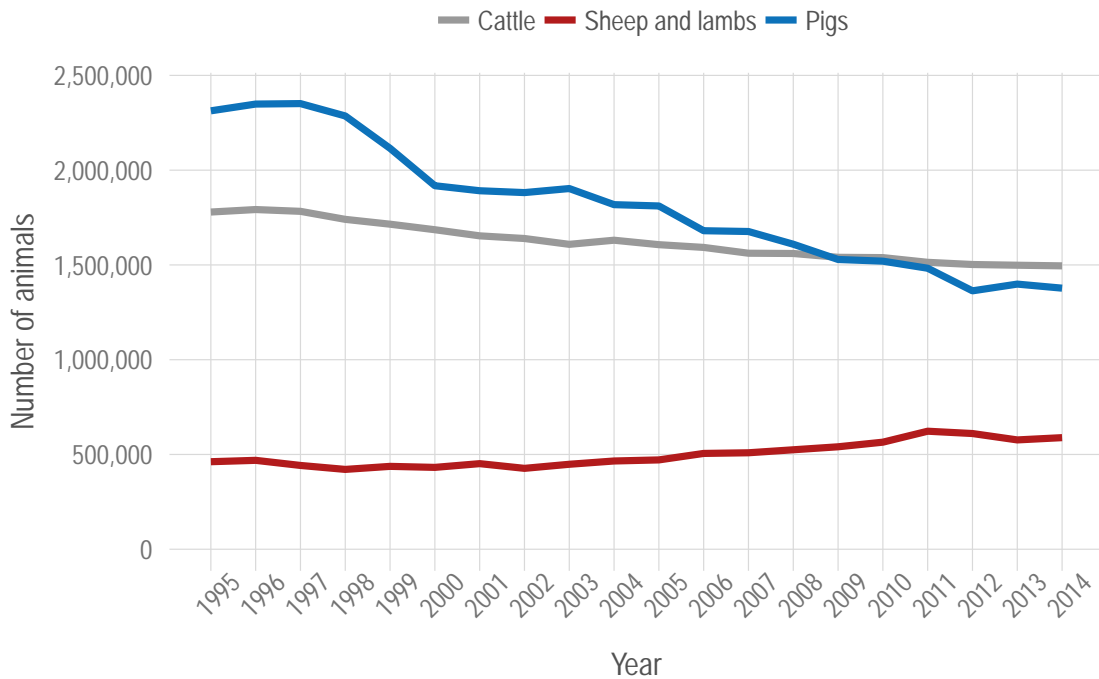


Figure 1: Number of Swedish livestock 1995-2014.

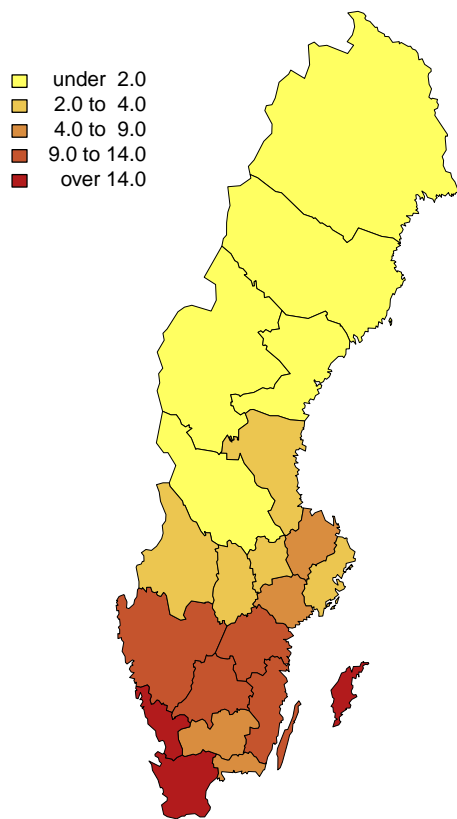


Figure 2: Number of cattle per km<sup>2</sup> in 21 Swedish counties as of June 2014.

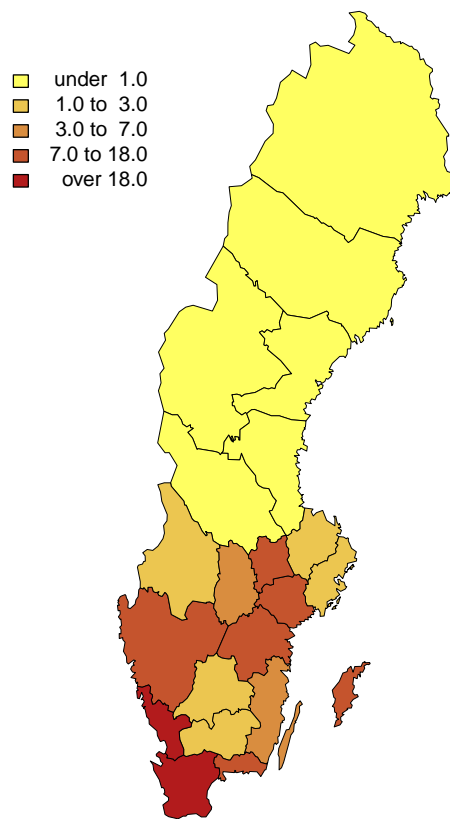


Figure 3: Number of pigs per km<sup>2</sup> in 21 Swedish counties as of June 2014.

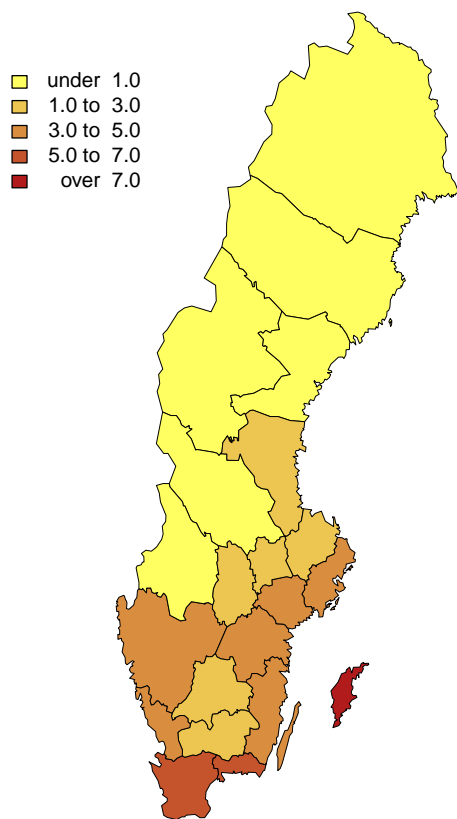


Figure 4: Number of sheep per km<sup>2</sup> in 21 Swedish counties as of June 2014.

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# 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 of the holding are included, as well as the name, address and telephone number of the keeper. All egg producers with a capacity of at least 350 laying hens and all those selling eggs for consumption must be registered. The register contains specific information about production method, capacity and the number of houses and sections on the holding.

## THE CENTRAL DATABASE OF ANIMAL MOVEMENTS

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

## THE CENTRAL DATABASE FOR BOVINE ANIMALS

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

## THE SLAUGHTER REGISTER

The Slaughter Register (SLAKT) is administered by the Swedish Board of Agriculture. The

abattoirs are responsible for reporting all slaughtered animals including wild game. The producer's organisation number or personal code number must be reported for all species except wild game. The holding number of the supplier is compulsory information for all species except horses and wild game. Reports must be made every week.

## THE DATABASE FOR DAIRY HERDS

The national coordinating organisation for dairy and beef production is Växa Sverige. The organisation is responsible for the database for dairy herds (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 FARM & ANIMAL HEALTH

Farm & Animal Health (formerly 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 individual animals. It is based on reports from practitioners to the Swedish Board of Agriculture. All veterinarians are obliged to continuously report activities of their veterinary practice on production animals. The purpose is to monitor the animal health situation in Sweden and use it as a base for preventive measures.

# Institutions, organisations and laboratories involved in monitoring



Photo: Karin Nilsson/SVA

## 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 con-

trol 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 collaborate with other authorities, county councils and municipal-

ities to develop a national knowledge support and to follow up interventions. The Public Health Agency of Sweden will promote health and prevent diseases by supporting communicable disease control with epidemiological and microbiological analyses. The authority 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 and parasites, as well as water and environmental analyses are carried out by the authority.

#### NATIONAL FOOD AGENCY

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

#### COUNTY ADMINISTRATIVE BOARD

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

#### FARM & ANIMAL HEALTH

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

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

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

#### LUNDEN ANIMAL HEALTH ORGANISATION

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

#### SWEDISH POULTRY MEAT ASSOCIATION

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

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

#### REFERENCES

[www.jordbruksverket.se](http://www.jordbruksverket.se)

[www.sva.se](http://www.sva.se)

[www.folkhalsomyndigheten.se](http://www.folkhalsomyndigheten.se)

[www.slv.se](http://www.slv.se)

[www.lst.se](http://www.lst.se)

[www.vxa.se](http://www.vxa.se)

[www.gardochdjurhalsan.se](http://www.gardochdjurhalsan.se)

[www.lundens.com](http://www.lundens.com)

[www.svenskfagel.se](http://www.svenskfagel.se)

[www.svenskaagg.se](http://www.svenskaagg.se)

[www.fiskhalsan.se](http://www.fiskhalsan.se)

# **Disease Surveillance 2014**

# Atrophic rhinitis

## BACKGROUND

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

tion 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. However, anytime AR is suspected in a herd, tests should be performed for the presence of toxigenic *P. multocida*. If toxigenic *P. multocida* is detected, the health declaration is withdrawn and restrictions on the sale of pigs are put in place until the herd is sanitised and declared free from the disease. Diagnostic tools developed by DAKO (Copenhagen, Denmark) and evaluated at SVA, during the late 1980s and early 1990s offered the possibility to combat AR in an effective way. Nasal swabs are cultured on a special media overnight. The entire microbial growth is harvested and diluted in water and the presence of the *P. multocida* toxin is assessed by an ELISA system.

## RESULTS AND DISCUSSION

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

Table 1: The total number of samples and the outcome of nasal swabs analysed for *P. multocida* 2005-2014. The samples have been collected in all nucleus and multiplying herds, as well as in production herds suspected for AR.

Year	Samples	Positive samples	Diagnosed herds
2005	2,413	29	2
2006	1,836	2	0
2007	1,878	1	0
2008	462	0	0
2009	1,724	10	1
2010	1,523	0	0
2011	1,323	0	0
2012	1,431	0	0
2013	1,027	0	0
2014	1,050	0	0

# Aujeszky's disease

## BACKGROUND

Aujeszky's disease (AD) virus is caused by a herpes virus with the capacity to infect several species but pigs are 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, that was introduced in 1991 and operated by the Farm & Animal Health. Farm & Animal Health is also responsible for the ongoing active surveillance programme and reports to the Swedish Board of Agriculture.

## DISEASE

The clinical presentation of AD is different depending on the age of the infected animal. The most severe clinical signs develop in newborn or very young piglets in which infection leads to neurological signs and nearly 100% mortality, whereas adult pigs show only mild respiratory signs and inappetence. In addition to the mild clinical signs, pregnant sows can abort as a consequence of the infection. Species other than pigs develop neurological signs including severe itch ('mad itch') and die within 1-2 days.

## LEGISLATION

The disease is included in the Swedish Act of Epizootic Diseases (SFS 1999:657 with amendments) and is thereby notifiable on clinical suspicion for all veterinarians and farmers. Sweden has been granted certain additional guarantees by the European Commission regarding AD, 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 (Svanoviri™, PRV-gB-Ab ELISA, Svanova) and in the case of clinical suspicion also for virus or viral genome. All analyses are performed at the National Veterinary Institute.

### Passive surveillance

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

### Active surveillance

In 2014, all samples collected in the abattoir sampling part of the surveillance carried out by the Farm & Animal Health for porcine respiratory and reproductive syndrome virus (PRRSV) were used for the active surveillance for AD. See chapter on PRRS for details on sampling and population. Ongoing testing of animals for export and at breeding centres adds to the active disease surveillance.

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

## RESULTS

### Passive surveillance

During 2014, two clinical suspicions of AD were investigated. In both herds, clinical signs from the central nervous system of newborn or young piglets were the main clinical manifestation. The herds were sampled for both AD, classical swine fever and 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 declared negative for AD.

## Active surveillance

In 2014, 2,028 samples corresponding to 676 herds sampled at slaughter were analysed within the active surveillance programme. All these samples were negative for antibodies to the AD virus.

Approximately 1,400 samples from animals for export and from breeding centres were tested during 2014 and all were negative for antibodies to AD virus.

## DISCUSSION

The purpose of the surveillance is to document freedom from the disease and to contribute to the maintenance of this situation by detection of an introduction of the disease before it is widely spread in the swine population. The design of the active surveillance has been changed several times since 2007 and since 2011 the AD surveillance is based solely on abattoir sampling in the PRRS surveillance programme. The effects on probability of freedom and sensitivity of the surveillance of these changes have not been evaluated (Table 2).

Table 2: Number of samples and sampling population included in the active surveillance of Aujeszky's disease 2007-2014.

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



# 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

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

### Active surveillance

#### Vector surveillance

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

#### Targeted risk based monitoring

For the 2014 Bluetongue surveillance, approximately 1,370 animals from 137 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 November 2014 until February 2015 and samples were analysed with the milk ELISA routinely used. The number of tested herds was sufficient to detect 2 % prevalence with 95% confidence.

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

## RESULTS

Two clinically suspect cases were investigated and tested during 2014, and found negative. All other testing performed in 2014 was also negative.

## DISCUSSION

In summary, no clinical suspicions of bluetongue were confirmed nor was there any indication of viral circulation during 2014.

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. In 2014 multiple outbreaks of BTV-4 were reported in Greece and Bulgaria. The virus spread rapidly and reached Hungary and Romania before the end of the vector season.

## REFERENCES

Ågren, E.C., Burgin, L., Sternberg Lewerin, S., Gloster, J., Elvander, M., 2010. Possible means of introduction of bluetongue virus serotype 8 (BTV-8) to Sweden in August 2008 - comparison of results from two models for atmospheric transport of the *Culicoides* vector. *Veterinary Record* 167:484-488.

Sternberg Lewerin, S., Hallgren, G., Mieziowska, K., Treiberg Berndtsson, L., Chirico, J., Elvander, M., 2010. Infection with bluetongue serotype 8 in Sweden 2008. *Veterinary Record* 167:165-170.

Nielsen S. A., Nielsen B. O., Chirico J., 2009. Monitoring of biting midges (Diptera: Ceratopogonidae: *Culicoides* Latreille) on farms in Sweden during the emergence of the 2008 epidemic of bluetongue. *Parasitology Research* 106:1197-1203.

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

In 1996, the disease became a public health concern, after the detection of a new variant of Creutzfeldt-Jacob Disease in humans (vCJD), likely to be linked to classical BSE in cattle. This resulted in actions taken to prevent transmission to humans through removal of specified risk material (such as brain and spinal cord) at slaughter, restrictions related to feed to avoid recycling of infectious material to ruminants through infected MBM and when a rapid test became available also an intensified surveillance.

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

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

## LEGISLATION

Surveillance and control is regulated through the Regulation (EC) No 999/2001 of the European Parliament and of the Council of 22 May 2001, on national level the sampling is regulated by SJVFS 2010:9 saknr K19, last amended through SJVFS 2013:3. BSE is a notifiable disease under the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments) and there is a scheme to compensate farmers for losses due to eradication measures.

## SURVEILLANCE

### Feed

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

### Animals

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

### Passive surveillance

All suspicions of BSE (bovine animals not responding to treatment, with clinical signs that are compatible with a BSE diagnosis) must be reported to the authorities. The obligation to report applies for animal owners, veterinarians and everyone else who is responsible for the animals. Samples are analysed with Bio-Rad TeSeE short assay protocol (SAP) in combination with Bio-Rad TeSeE Western Blot.

*Active surveillance*

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

The following categories were sampled in the active surveillance:

- Cattle of Swedish<sup>1</sup> origin above 48 months of age that have remarks at antemortem inspection before slaughter or are emergency slaughtered.
- Cattle of other than Swedish<sup>1</sup> 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<sup>1</sup>.
- All fallen stock (animals dead or killed on farm but not slaughtered for human consumption) above 48 months of age that originate in Sweden. For cattle that originate in a country other than Sweden, the age limit for sampling is 24 months. The animals are sampled at the rendering plants or at necropsy. Sweden applies derogation (Regulation (EC) 999/2001) for remote areas with a low cattle density, where no collection of dead animals is organised. The cattle population in these areas does not exceed 10% of the total bovine population in Sweden.

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

**RESULTS***Feed*

In 2014, 145 feed samples were taken at feed mills. All of these samples were negative. No samples were collected at primary production at farm level during 2014.

*Animals**Passive surveillance*

In 2014, four cattle were examined due to clinical suspicion, all with negative results.

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

*Active surveillance*

In 2014, 9,447 samples were examined for BSE. All samples were negative. Of these samples 9,152 were from fallen stock, 62 samples were from animals with remarks at antemortem inspection before slaughter, 229 samples were from emergency slaughtered animals.

**DISCUSSION**

No positive BSE cases were detected. Preventive measures have been in place for many years and the fact that no cases were detected supports that these measures have been effective. The low number of clinical suspicions may be an indication of a lower degree of awareness among farmers and veterinarians compared to 10 years ago.

Reports of prion transmission studies including several passages in different species have shown that prion-strains do not always remain stable through these passages. The source of the large epidemic of classical BSE has not been determined and atypical cases cannot be excluded as the source. Thus, the atypical cases may be a potential source of a new epidemic. As the number of cases of classical BSE is decreasing within the European Union, surveillance is decreasing and suggestions have been made to allow the use of MBM in feed within the EU. Strict separation and bans of these feeding practices must be kept in place to avoid any possibility of recirculation of BSE if it were to enter the system again.

**REFERENCES**

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

Capobianco R et al. (2007) *PLoS Pathog.* Conversion of the BASE prion strain into the BSE strain: the origin of BSE? Mar;3(3):e31.

EFSA Scientific Report on the Assessment of the Geographical BSE-Risk (GBR) of Sweden. Adopted July 2004 (Question No EFSAQ-2003-083). Last updated 8 September 2004. Publication Date 20 August 2004 [http://www.efsa.europa.eu/en/science/tse\\_assessments/gbr\\_assessments/572.html](http://www.efsa.europa.eu/en/science/tse_assessments/gbr_assessments/572.html)

# Bovine viral diarrhoea



Photo: Bengt Ekberg

## 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 eventod 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 Växa in 1993. The government and the farmers share the costs for sampling and testing. Since June 2001, there is also a compulsory control programme requiring all cattle herds to be tested for BVDV on a regular basis. Since 2014, Sweden is considered free from BVD.

## DISEASE

BVDV may induce disease of varying severity, duration and clinical signs after an incubation period of 6-12 days. Fever, depression, respiratory distress, diarrhoea are typical signs of acute BVD. In pregnant cattle, infection may result in reproductive failure such as abortion, stillbirth or the birth of calves that are persistently infected with

the virus. A more uncommon form of BVD is mucosal disease, that may occur in an acute or chronic form in persistently infected animals.

## LEGISLATION

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

## SURVEILLANCE

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

Surveillance of dairy herds is performed by sampling bulk milk in conjunction with milk quality testing. The laboratory gets an order from Växa Sverige (the former Swedish Dairy Association) about which herds to sample. All samples are marked using bar code labels. Surveillance of beef herds is performed by blood sampling at slaughter. Field testing can also be carried out as a backup component if case herds cannot be accessed through the abattoir or through sampling of bulk milk. The scheme is designed to detect the presence of infection at a herd design prevalence of 0.02%, with 99% confidence. The

within-herd design prevalence is set to 30%. In case of re-appearance of BVD, herds that are infected will be screened, and persistently infected virus carriers identified and removed. Details on numbers of samples and herds tested 2014 are given in tables 3 and 4

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

## RESULTS

Table 3 shows the numbers of antibody positive bulk-milk samples, slaughter samples, and field samples tested in 2014. As shown in table 4, a total of 13 herds (2 dairy herds and 11 beef herds) were antibody positive during the year.

All those herds were investigated and considered to be non-infected. In 2014, no newly infected herds were identified and no virus positive animals were born.

## DISCUSSION

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

## REFERENCES

Swedish Dairy Association, Statistics for 2014.

Table 3: Total numbers of samples with different contents of BVDV antibodies tested in 2014.

Sample type	Class/Finding	Herds	Animals
Bulk milk	0-1 <sup>A</sup>	4,479	–
Bulk milk	2-3 <sup>A</sup>	0	–
Blood sample at slaughter	Negative	–	11,957
Blood sample at slaughter	Positive	–	15
Field sample	Negative	–	2,052
Field sample	Positive	–	5

<sup>A</sup> 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 2014 divided by herd level risk

Herd level risk <sup>A</sup>	Herd numbers (N)	Surveillance area	
		Dairy	Beef
<i>Low risk</i>	N of herds	3,017	7,944
	N of herds tested	1,322	2,329
	N positive	1	7
<i>Medium risk</i>	N of herds	1,514	1,690
	N of herds tested	1,425	1,223
	N positive	0	3
<i>High risk</i>	N of herds	433	317
	N of herds tested	389	295
	N positive	1	1

<sup>A</sup> Based on the number of herds they have purchased from and sold to during the preceding 12 month period

# Brucellosis

## BACKGROUND

Brucellosis is caused by a zoonotic, gram-negative bacterium belonging to the genus *Brucella*. Most human cases are caused by four species, each having a preferred animal host. *Brucella melitensis* occurs mainly in sheep and goats, *Brucella suis* in pigs, *Brucella abortus* in cattle and *Brucella canis* in dogs. The infection is transmitted by contact with 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. Between 4 and 13 human cases have been reported annually. Most of these patients have acquired the infection outside Sweden or via consuming products from endemic countries, except for one case which was acquired by laboratory infection.

## 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. Genitourinary

involvement occurs in 2-20% of the human cases. The mortality rate is low, around 2%.

## LEGISLATION

### Animals

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

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*

Suspicions 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 fetuses of ruminants and pigs.

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. In 2014 one imported Russian mix-breed dog with discospondylitis was positive for brucellosis. The serological diagnosis could not be confirmed with bacterial culture, probably due to treatment with antibiotics. Another dog in the same household was tested negative.

##### *Humans*

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

#### Active surveillance

##### *Animals*

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

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

##### *Surveillance for brucellosis in cattle*

From 1997 and onwards, approximately 3,000 samples (bulk milk and/or serum samples) have been tested each year for antibodies against *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 will be performed next time in 2016.

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

##### *Surveillance for brucellosis in sheep and goats*

Serum samples were tested for antibodies against *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 2014 was designed with a between-herd design prevalence of 0.2%, a within-herd prevalence of 40% and a risk of introduction of 1 in 25 years. Sample size is calculated on a yearly basis to reach a probability of freedom of 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 in 2009, serum samples will be tested every second year, and therefore this sampling was not performed in 2014.

The pig surveillance of 2013 was designed with a between-herd design prevalence of 0.5%, a within-herd prevalence of 40% and a risk of introduction of 1 in 25 years. Sample size is calculated on a monthly basis to reach a probability of freedom of 99% at the end of the year. To reach this level of probability of freedom, 750 samples over the year (1 sample per herd from 750 herds per year) is needed.

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

**RESULTS**

## Passive surveillance

*Animals*

During 2014, a clinically suspect case was reported from one sheep herd. In addition to this, a sample from an animal in another sheep herd taken prior to export was serologically positive for *Brucella ovis*. There were no clinical signs of brucellosis in this herd. In both cases, samples from testicle and epididymis were taken for bacteriological culture. All samples were negative. No clinical suspicion was seen in any other animal species.

As mentioned above, an imported dog was serologically positive for *Brucella canis*.

All other samples, serological and bacteriological, from passive surveillance were negative.

Within the surveillance of aborted fetuses, 32 bovine, 28 ovine, 2 caprine, and 31 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 to a mother infected in Syria while she was pregnant. *Brucella* was isolated in blood from both mother and child. The child was healthy but was sampled since *Brucella* was detected in her mother. In 2013, 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*.

In 2014, 16 cases were reported, countries of infection were: Iraq (7 cases), Syria (6 cases), Ethiopia (1 case), Kenya (1 case) and Somalia (1 case). There was as many female as male cases in 2014.

## Active surveillance

*Animals*

During 2014, 2,996 ovine and caprine serum samples from 768 individual holdings were analysed for *B. melitensis*. The number of samples was lower than planned but still the probability of freedom over the year was close to 99%

**DISCUSSION**

In summary, *Brucella* infection was not detected in cattle, sheep, goats or pigs during 2014. 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 are brought into Sweden every year. It is important to be aware of the risk this group of dogs represents, for *Brucella* infection as well as for other diseases.

# Campylobacteriosis



Photo: woodley wonderworks CC BY 2.0

## 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 5). Of these, approximately 20-40% have been reported as domestic.

## DISEASE

### Animals

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

### Humans

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

## LEGISLATION

### Animals

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

## Food

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

## Humans

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

## SURVEILLANCE

## Animals

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

## Food

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

## Humans

Surveillance in humans is passive.

## RESULTS

## Animals

In 2014, thermophilic *Campylobacter* spp. were detected in 363 (11.5%) of the 3,162 broiler flocks at slaughter in the national *Campylobacter* programme (Figure 6). A seasonal variation of *Campylobacter* in broilers was observed with the least findings in winter and most in the summertime. In November-December 2014, *Campylobacter* was detected in a larger proportion of flocks compared with the same period in previous years.

## Food

A study was performed on the associations between *Campylobacter* in chicken caecum, carcass skin, underlying breast muscle and packaged breast fillets. *Campylobacter* spp. were isolated from caecal samples from 41 flocks. Moreover, *Campylobacter* spp. were enumerated in 194 (68%) skin samples and 13 (5%) underlying muscle samples. *Campylobacter* could only be quantified in those breast muscle samples with a corresponding positive skin sample.

The results showed a significant association ( $P < 0.05$ ) between findings of *Campylobacter* on carcass skin (log cfu/g) and the proportion of *Campylobacter* positive breast muscle samples.

The samples taken by the local authorities were mostly taken as part of an investigation of a complaint or a suspected food poisoning (49 of 57). One sample was positive for *Campylobacter*.

## Humans

In 2014, 8,288 cases of campylobacteriosis were reported. A majority of the reported cases were infected outside Sweden. Of the reported cases, 45% (3,709 cases) were domestic. The incidence in domestic cases increased by 12% from the year before to 38.1/100,000 inhabitants, which is the highest incidence since the infection was made notifiable in 1989.

The number of notified cases of campylobacteriosis usually increases during the summer, and this also happened in 2014. However, in 2014 there was an unusual peak in December. During the same period, *Campylobacter* was detected in a larger proportion of poultry flocks than usually during this time of the year, but it is unclear if this contributed to the increase in human incidence.

Among the cases who acquired their infections in Sweden in 2014, the incidence was highest in the age group of 40-49 years. During the last decade there has been an increase in incidence in all age groups above 10 years of age. As usual, there were more men (57%) than women reported with campylobacteriosis.

In 2014, three outbreaks of campylobacteriosis were reported.

- In mid-February, 66 persons fell ill with stomach pain, diarrhoea, fever and joint pain after having eaten in the same canteen. The kitchen was regarded to be generally very clean and tidy and the infection was thought to have been brought in via some contaminated vegetable.
- In the end of April a preschool group of 20 children and some of their family members visited a farm where they had buns and unpasteurized milk. A few days later, eleven people fell ill with stomach aches. Samples were taken and *Campylobacter* was found both in humans, animals and in the environment inside the barn. An epidemiological study was conducted and it pointed to milk as the probable source of infection.
- During the summer, seven persons from

a few different families who took their drinking water from the same well got ill. *Campylobacter* was detected both in people and in the water and typing confirmed that the well water was the source of infection.

## 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 reported (Figure 6). Reasons for this decrease are not clear but might be related to improved hygienic barriers and/or unusually dry weather conditions in the summer 2013. In 2014, however, the prevalence in broiler flocks was 11.5%, which is an increase compared to the previous two years. In 2014, thinning was more commonly practiced which might have increased the prevalence of *Campylobacter* in broilers.

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

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

Strict hygiene in the kitchen is essential to avoid cross-contamination between contaminated food and food that will not be heated such

as raw vegetables. Likewise good hygiene is important when preparing food for social gatherings.

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

## REFERENCES

- Lindqvist R, Lindblad M. Quantitative risk assessment of thermophilic *Campylobacter* spp. and cross-contamination during handling of raw broiler chickens evaluating strategies at the producer level to reduce human campylobacteriosis in Sweden. *Int J Food Microbiol.* 2008; 121:41-52.
- Hansson I, Vågsholm I, Svensson L, Olsson Engvall E. Correlations between *Campylobacter* spp. prevalence in the environment and broiler flocks. *J Appl Microbiol.* 2007; 103:640-9.
- Hansson I, Nyman A, Lahti E, Gustafsson P, Olsson Engvall E. Associations between *Campylobacter* levels on chicken skin, underlying muscle, caecum and packaged fillets, *Food Microbiology*, June 2015, 178--181.
- Kirkpatrick, BD and Tribble DR. 'Update on human *Campylobacter jejuni* infections.' *Curr Opin Gastroenterol* 2011; 27: 1-7.
- Lindblad M, Lindmark H, Lambertz ST, Lindqvist R. Microbiological baseline study of broiler chickens at Swedish slaughterhouses. *J Food Prot.* 2006; 69:2875-82.
- Newell, DG, Elvers KT, Dopfer D, Hansson I, Jones P, James S, Gittins J, Stern NJ, Davies R, Connerton I, Pearson D, Salvat G, Allen VM. Biosecurity-based interventions and strategies to reduce *Campylobacter* spp. on poultry farms. *Appl Environ Microbiol* 77(24): 8605-8614.

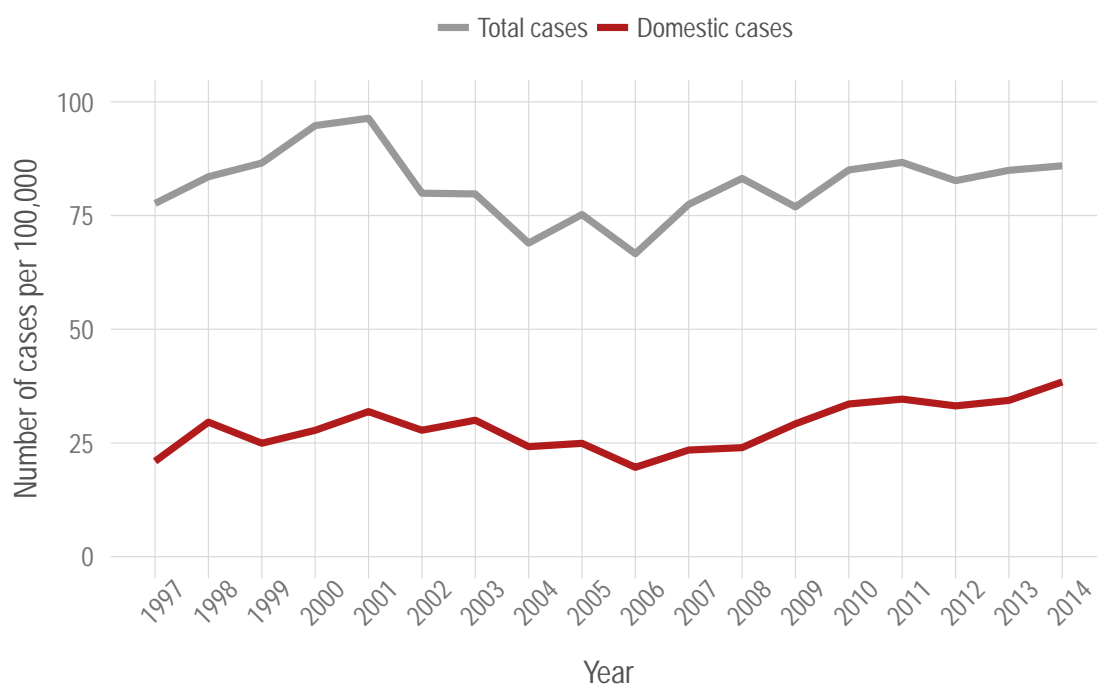


Figure 5: Notified incidence (per 100,000 inhabitants) of human cases of campylobacteriosis in Sweden, 1997-2014

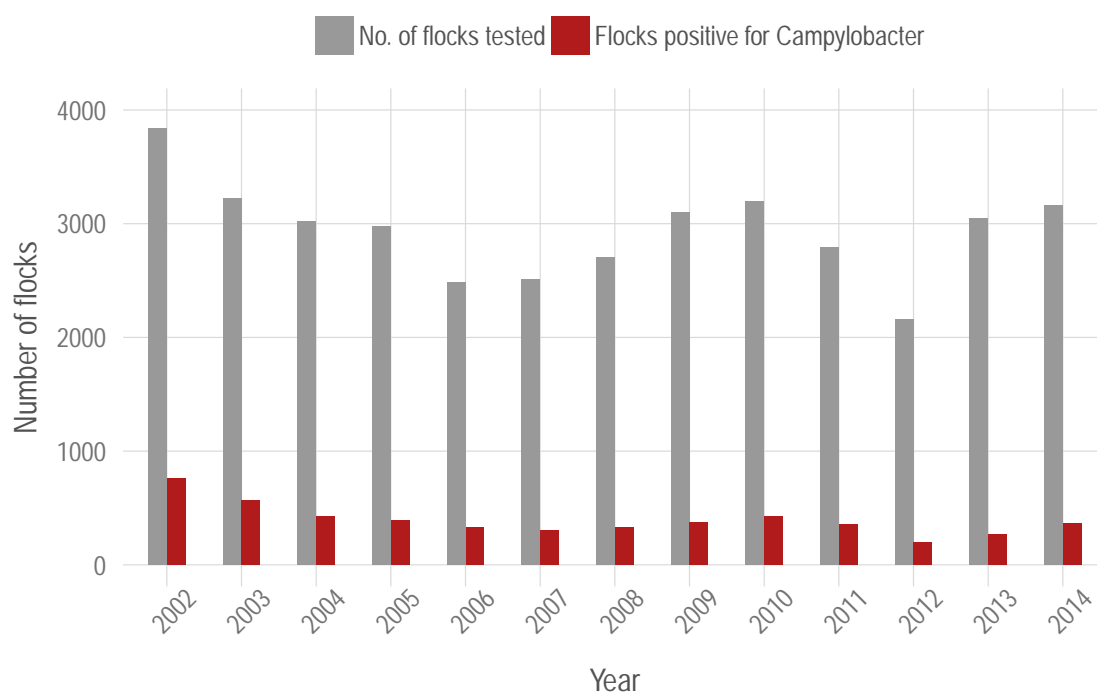


Figure 6: Prevalence of *Campylobacter* in broiler flocks in 2002-2014.

# 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 these two viruses are not related. CSF is considered one of the most important and devastating pig diseases worldwide. During 1997-98 an extensive outbreak occurred in the Netherlands, Germany, Belgium and Spain. Since then, outbreaks in Europe have been confined to more limited geographic regions although the outbreaks in Lithuania 2009 and 2011 involved very large farms and are thus considered extensive. In 2012 CSF was reported from Latvia and is still present in the wild boar population there. Ukraine recently reported CSF in wild boar and CSFV is also present in Russia as well as in Asia and South America. CSF has not been diagnosed in Sweden since 1944 and Sweden got official status as a historically CSF free country in February 2015.

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

## DISEASE

CSF appears in different clinical forms; acute, chronic and a mild form with reproductive disorders as the main clinical manifestation. The incubation period is 2-14 days and the acute form of the disease includes high fever (<42°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 presence of clinical signs and production results. Due to the similarity of clinical signs, samples are analysed for both CSF and ASF. This strategy is strongly recommended by the EU.

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

### Active surveillance

Samples collected for the abattoir sampling part of the surveillance carried out by the Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS) were used for the active surveillance. See chapter on PRRS for details on sampling and population. The surveillance was designed 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 2,280 samples over the year (2 samples per herd from 95 herds per month) were needed, based on structure of the pig production in 2013. Ongoing testing of animals bound for export and at breed-

ing centres adds to the active disease surveillance of CSF.

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

## RESULTS

### Passive surveillance

Five investigations following clinical suspicion of CSF were carried out during 2014. The clinical manifestations included reproductive failure, neurological signs and haemorrhages in piglets and circulatory disorders in sows. Following further investigations, including sampling, the herds could be declared negative for CSF (all investigations except one also included testing for PRRS, Aujeszky's disease and/or African swine fever).

Within the surveillance of aborted foetuses, 29 foetuses from 11 herds were examined for the CSF viral genome and all samples were negative.

### Active surveillance

Serum samples from 2028 pigs were analysed and in none of them antibodies to CSFV could be found. The number of samples tested for CSF was slightly lower than planned and taking

into account the outcome of the surveillance, the probability of freedom on a monthly basis during 2014 was 99%.

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

## DISCUSSION

The results from the passive and active surveillance for CSF in Sweden during 2014 add to the documentation of freedom from this infection in the Swedish commercial pig population. During recent years the Swedish pig industry has undergone heavy structural changes leading to a rapidly declining number of herds and extensive changes in the market and in the habits of farmers. The active surveillance in terms of planning design and number of samples is therefore evaluated yearly and adjusted accordingly if needed.

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

# Coccidiosis and clostridiosis

## BACKGROUND

Coccidiosis and clostridiosis are intestinal diseases that commonly affect broiler chickens 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 longterm goal is to replace anticoccidials by other preventive measures.

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

## RESULTS AND DISCUSSION

In 2014, a lesion score (MTLS/Mean Total Lesion Score) of > 2.5 was not found in any of 36 investigated broiler flocks.

Samples for histological examination of the liver were submitted from abattoirs from 38 broiler flocks with > 0.5% condemnation due to liver lesions. Lesions consistent with clostridiosis (i.e. cholangiohepatitis) were observed in 31 out of the 38 flocks.

In 7 samples, lesions were found suggestive of IBH (Inclusion Body Hepatitis) in broilers caused by adenovirus (FADV - Fowl adenovirus).

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

## REFERENCES

Johnson J, Reid WM (1970). Anticoccidial drugs: lesion scoring techniques in battery and floor-pen experiments with chickens. *Exp. Parasitol* 28, 30-36.



# Echinococcosis

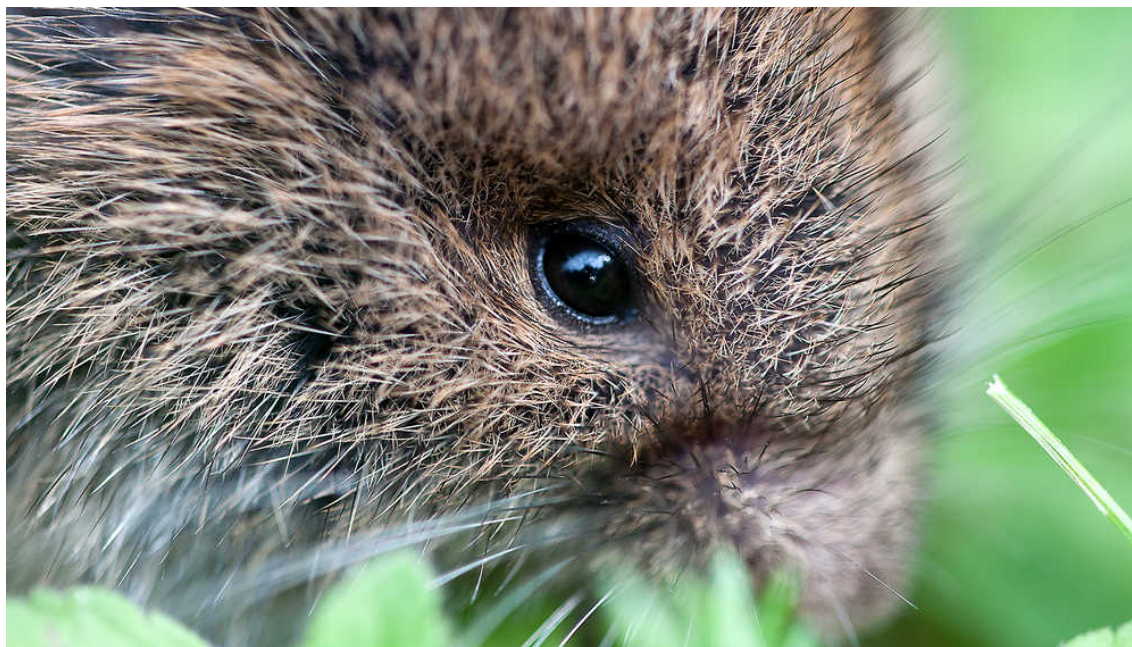


Photo: Anders Lindström/SVA

## BACKGROUND

Echinococcosis is a common name for different diseases in humans caused by tapeworms belonging to the genus *Echinococcus*. Although the genus contains several species, only the species of *E. granulosus* and *multilocularis* exist in Europe. The life cycles of these parasites are completely different but both require two hosts: a definitive and an intermediate host. Humans are dead-end hosts of these parasites and may become infected by accidental ingestion of the eggs.

# Alveolar echinococcosis

## BACKGROUND

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

## HISTORY

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

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

A second national screening was initiated in 2012 and continued in 2013 and 2014.

From known infected areas, hunters were asked to submit 30 foxes from each area. Sampling was initiated in 2012 and continued in 2013 and 2014.

Within an ongoing Emiro research project ([www.emiro.org](http://www.emiro.org)) and FoMA Zoonos monitoring programme (<http://www.slu.se/en/environment>) at the Swedish University of Agricultural Sciences (SLU) initiated in 2012, intensive sampling of rodents and fox scats are performed to increase the knowledge of the epidemiology of this parasite in Sweden.

In 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 the country. However, as the prevalence of the parasite in foxes is very low in Sweden compared to many European countries, dog owners are encouraged to deworm their dogs prior to entry to Sweden.

### Humans

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

## SURVEILLANCE

### Animals

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

The second national screening, initiated in 2012, continued in 2013 and 2014. A network of

local hunters, coordinated by the Swedish Association for Hunting and Wildlife Management was responsible for the sampling. In certain areas, intensive fox faecal and rodent sampling was also carried out by the Swedish University of Agricultural Sciences (SLU). 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 assuming 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.

From the four known infected areas (Gnesta and Katrineholm in Södermanlands County, Västra Götaland and Dalarna County), hunters were asked to submit 30 foxes from each area. This sampling was done to obtain material for further subtyping. Sampling was initiated in 2012 and continued in 2013 and 2014. The foxes were tested with MC-PCR and positive foxes were further investigated with SSCT.

All free-living wolves submitted to necropsy at the National Veterinary Institute were analysed with MC-PCR.

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

Humans

Surveillance in humans is passive.

## RESULTS

Animals

The second national screening was initiated in 2012 and finalized in 2014. During 2014 a total of 513 fox scat samples were collected and analysed and one was positive (Gnesta, Södermanland County). In all, during 2012-2014 a total of 2,779 fox scat samples were analysed and three positive fox scats were identified, one from Gnesta and one from Katrineholm (Södermanland County) and one from Västra Götaland County.

In the sampling of foxes from the four known infected areas to obtain material for further subtyping, 25 foxes were analysed during 2014 (20 from Katrineholm and five from Gnesta). Of these, three foxes were positive, two from Katrineholm and one from Gnesta (Södermanlands County).

Within the Emiro project and FoMA Zoonos monitoring program, the parasite was found for the first time in an intermediate host, voles in 2014. The voles were caught in Södermanlands county (Gnesta/Nyköping) in 2013 (n=1) and in 2014 (n=3). In the analysis of fox scat samples, this project also identified a new infected area, Växjö-region in Kronoberg County. A total of 11 positive samples were found, six in Södermanlands, two in Kronobergs and three in Västra Götalands County.

During 2014, faecal samples were collected at necropsy from 17 Raccoon dogs (*Nyctereutes procyonoides*) and 29 wolves (*Canis lupus lupus*) and faecal samples were submitted to the National Veterinary Institute from four dogs, one wolverine (*Gulo gulo*) and one fox and tested with the MC-PCR. In addition, at necropsy one otter (*Lutra lutra*) was analysed for *E. multilocularis*. All were negative. These samples were not included in any monitoring project.

Humans

In 2014, there were no cases of alveolar echinococcosis reported.

## DISCUSSION

*E. multilocularis* is considered to be endemic at a very low prevalence in Sweden. It is not known if, and in that case, when the parasite was introduced into the country. The national screening finalized in 2014 has described the present national prevalence and can be used as a baseline. If national screenings are repeated with, for exam-

ple, 5 or 10 years intervals this will clarify if the prevalence changes over time. It is well known that the prevalence of this parasite varies geographically. And regional screenings have earlier shown a prevalence of 0.8 % in a part of Södermanlands County. Within the Emiro project and FoMA Zoonos monitoring program, a fifth infected area was identified, Våxjö in Kronoberg County in 2014. Thereby *E. multilocularis* has been detected in all four areas investigated in this project. Based on earlier findings it has been concluded that the parasite is endemic in the country, however the true geographical distribution is unknown. If monitoring continues it is probable that new infected areas will continue to be detected.

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

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

#### REFERENCES

Dinkel, A., von Nickisch-Rosenegk, M., Bilger, B., Merli, M., Lucius, R., & Romig, T. (1998). Detection of *Echinococcus multilocularis* in the Definitive Host: Coprodiagnosis by PCR

as an Alternative to Necropsy. *Journal of clinical microbiology*, 36(7), 1871-1876.

Trachsel, D., Deplazes, P., & Mathis, A. (2007). Identification of taeniid eggs in the faeces from carnivores based on multiplex PCR using targets in mitochondrial DNA. *Parasitology*, 134(6), 911.

Isaksson, M., Hagström, A., Armua-Fernandez, M., Wahlström, H., Ågren, E., Miller, A., Holmberg, A., Lukacs, M., Casulli, A., Deplazes, P., Juremalm, M. (2014). A semi-automated magnetic capture probe based DNA extraction and real-time PCR method applied in the Swedish surveillance of *Echinococcus multilocularis* in red fox (*Vulpes vulpes*) faecal samples. *Parasites & vectors* 7, 583.

Wahlström H, Lindberg A, Lindh J, Wallensten A, Lindqvist R, et al. (2012) Investigations and actions taken during 2011 due to the first finding of *Echinococcus multilocularis* in Sweden. *Euro surveill.* 17.

Andrea L. Miller, A.L., Olsson, G.E., Skarin, M., Ley, C., Wahlström, H., Höglund, J. (2014). *Echinococcus multilocularis* and other taeniid parasites in rodents in Sweden. 6<sup>th</sup> Conference of the Scandinavian-Baltic Society for Parasitology, Uppsala, Sweden.

# 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 localization 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). However, notification on species level is not required. If cases of *E. multilocularis* occur in humans the data will be presented in the annual

report at the website of the public health agency of Sweden ([www.folkhalsomyndigheten.se](http://www.folkhalsomyndigheten.se)). Before 2004 *Echinococcus* spp. was voluntarily reported by the laboratories.

## SURVEILLANCE

### Animals

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

### Humans

Surveillance in humans is passive.

## RESULTS

### Animals

During 2014 no suspect lesions from reindeer were found at meat inspection. A total of 29 wolves submitted for necropsy were tested with the SSCT. *E. granulosus* was not detected in any animals in 2014.

### Humans

In 2014, 21 cases of cystic echinococcosis were reported. Annually around 15-20 cases are reported in Sweden. However, during 2010, 29 cases were reported which may have been due to a delay in the reporting of cases from the previous year. In 2014, the reported cases ranged in age from 17 to 73 years (median 36 years), 7 were women and 13 were men and one case where the sex of the patient was not recorded. 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 characterized 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 surveil-

lance, 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 betweenherd design prevalence is 0.2% and the within-herd design prevalence 15%, with a 99% confidence. Details on numbers of herds and animals tested in 2014 are given in table 5.

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

## RESULTS

No positive samples were found in 2014.

## 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 2014.

Table 5: Total numbers of herds and animals tested for EBL antibodies in 2014.

Herd type (sample type)	Herds	Animals
Dairy herds (1 bulk milk sample per herd)	1,596	–
Beef herds (blood from 1-3 animals per herd)	2,914	6,260
Beef herds with at least three animals tested	1,069	–
Beef herds with two tested animals	719	–
Beef herds with one tested animal	1,126	–

# Footrot



Photo: Bengt Ekberg

## 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 Farm & Animal Health 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 interdigital skin to complete underrunning of hoof horn.

## LEGISLATION

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

## SURVEILLANCE

The aim of the control programme is to eliminate footrot from affected sheep flocks and to provide certification of freedom from footrot for the sheep trade. Another important part of the programme is training of veterinarians and non-veterinary staff to perform clinical inspection and footrot scoring. 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 baths, moving to clean pastures and culling of chronically infected sheep. Flocks with a history of footrot can be certified as free, 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. Testing strains for virulence and mul-

multiple samples in a pool are recent improvements.

**RESULTS**

During 2014, 11 flocks were detected with footrot, compared to 47 flocks during 2007 (Figure 7). In the programme, measures were taken in 79 flocks and 275 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.

**REFERENCES**

Frosth S, Slettemeås JS, Jørgensen HJ, Angen O, Aspán A: Development and comparison of a real-time PCR assay for detection of *Dichelobacter nodosus* with culturing and conventional PCR: harmonisation between three laboratories. *Acta Veterinaria Scandinavica* 2012, 54:6

U König, A-K J Nyman, K de Verdier: Prevalence of footrot in Swedish slaughter lambs. *Acta Veterinaria Scandinavica* 2011, 53:27.

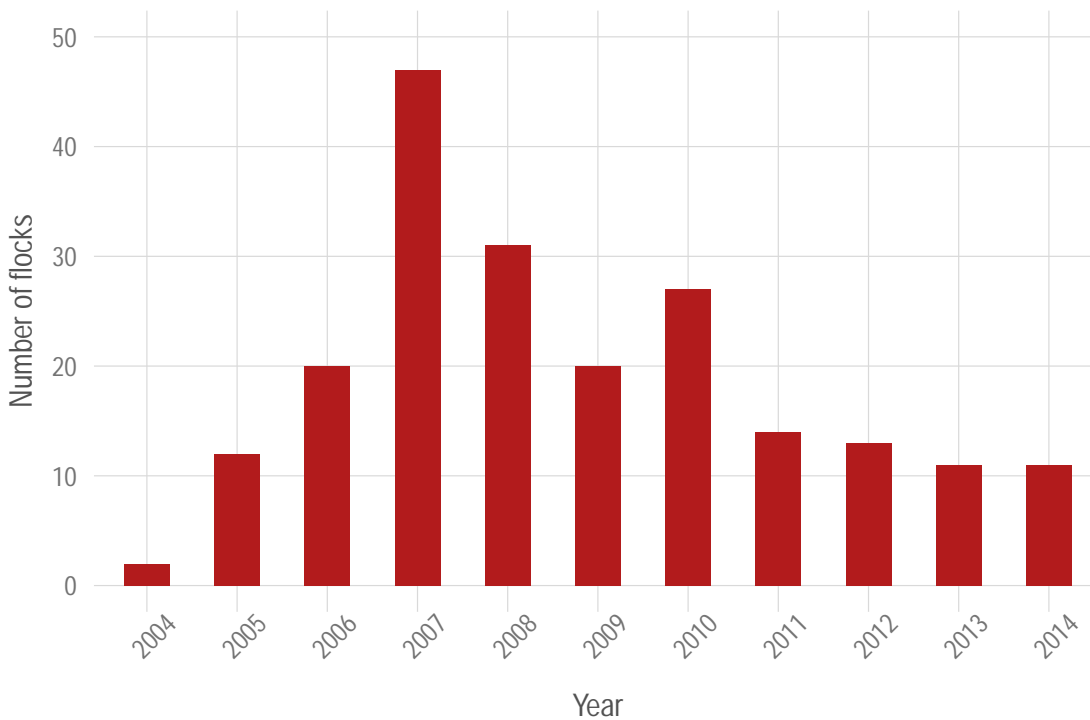


Figure 7: Number of sheep flocks detected with footrot 2004-2014



# Infectious bovine rhinotracheitis



Photo: Bengt Ekberg

## BACKGROUND

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

Examination of Swedish bulk milk samples during the early nineties showed the presence of a small number of seropositive herds. No signs of clinical disease were present in these herds. An eradication programme was initiated in 1994 and the last seropositive animal was found in 1995.

## DISEASE

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

## LEGISLATION

The Swedish IBR eradication programme was approved in 1994 (Decision 73/94/ COL and Decision 95/71/EC). Sweden was allowed additional guarantees by the EU to reduce the chance of IBR introduction in 1995 (Decision 95/109/EC) and was officially declared free from IBR in 1998 (former Decision 98/362/ EC, current Decision 2004/558/ EC). Since 2004, all neighbouring Nordic countries have additional guarantees from the EU relating to this disease (Decision 74/94/ COL and Decision 95/71/EC). IBR is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). Vaccination is prohibited and notification of clinical suspicion is mandatory.

## SURVEILLANCE

All diagnostic testing as outlined below was performed at the National Veterinary Institute. Milk and sera were analysed for the presence of antibodies using an indirect ELISA (SVANOVIR™ IBRab, Svanova®). A blocking-ELISA IBR/BHV-1 gB Ab ELISA kit (IDEXX) was used for confirmatory testing. Semen and organ samples were tested with a real time PCR. A positive case is defined as an animal with a posi-

tive PCR result or a confirmed positive serological reaction for IBR.

### Passive surveillance

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

### Active surveillance

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

on a herd design prevalence of 0.2%, an animal design prevalence of 10% (beef cattle) and a confidence level of 99%.

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

## RESULTS

Within the active surveillance, 3,126 bulk milk samples and 6,579 serum samples from beef cattle were examined. 511 cattle were tested at semen collection centres and 75 cattle, 1 European bison and 1 lama were tested prior to export. All samples were tested negative. Within the clinical passive surveillance, 1 bovine herd was investigated by serology and 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 2014. 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 2014, there were no outbreaks of HPAI or LPAI in Sweden. In the European Union (EU) ten outbreaks of HPAI were reported, the Netherlands (5), Germany (3), Italy (1) and UK (1). All HPAI subtyped as H5N8. For LPAI, 9 outbreaks in poultry were reported; Germany (2), Italy (5), and the Netherlands (2). In the cases where subtyping was available, H5N1 and H5N2 was the most common types and H5N3 was identified in one case.

### Animals

Morbidity in birds infected with HPAIV may be as high as 100%, but depends on the species affected, co-infections, virulence of the virus and other factors. In general, gallinaceous birds including turkeys and chickens suffer a more severe disease than waterfowl such as ducks and

geese, which may only exhibit minor or no clinical disease. LPAIV infections most often cause asymptomatic infections or mild respiratory disease. HPAIV infections cause variable clinical signs such as cyanosis, respiratory distress, diarrhoea, nervous signs, depression, decreased food and water intake and decreased egg production with altered egg quality. Sometimes the only clinical sign is sudden death of a large numbers of birds. In the case of the H5N8 infections in 2014 the only observed clinical sign was a moderate increase in mortality.

### 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 2014 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 2014, 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, 1,920 samples were taken. Table 6 gives an overview of all poultry flocks sampled in 2006 to 2014. In addition to the surveillance programme, samples were taken on clinical suspicion of avian influenza. On clinical suspicion of AI or Newcastle disease, laboratory analyses for both diseases are generally performed.

The surveillance programme for 2014 was based on representative sampling and the serological analyses were performed at the National Veterinary 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 OIE 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 figure 8. Swab samples (both cloacal and tracheal) taken from these birds were analysed for the detection of avian influenza viral genome by using an M-gene qRT-PCR. Positive samples are further analysed for detection and identification of H5 and H7 viruses, including virus pathotyping by amplicon sequencing.

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

#### Humans

Every year during the influenza surveillance season 1,500-2,000 samples are collected from sentinel (a surveillance system for influenza) patients with influenza like illness. These samples are analysed for influenza A and B. If influenza A is detected, further subtyping is performed into A(H1N1)pdm09 and A/H3N2. Influenza A/H3N2 positive samples from patients below 15 years are further analysed for A/H3N2v. A/H3N2v originates 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. A further 200-300 of the influenza positive samples from the diagnostics laboratory are subtyped/characterized. The Public Health Agency of Sweden, also performs a specific PCR for A/H5N1 and A/H7N9 if requested.

## RESULTS

#### Poultry

From the surveillance, no antibodies to avian influenza virus subtype H5 and H7 were detected in any of the sampled holdings. In 2014, 16 clinical suspicions were raised based on clinical signs, postmortem examinations, production losses and/or eggshell abnormalities. One of the suspicions was in a hobby flock and 15 in commercial holdings. All clinical suspicions were negative for influenza.

#### Wild birds

Within the passive surveillance programme, 263 wild birds of 55 different species were sampled of which 37 individual birds were waterfowl or shorebirds. One young mallard was positive for avian influenza but not of the notifiable H5 or H7 type. 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 dependent 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 2014, there has been a considerable increase in frequency of avian influenza reports of infected wild birds globally. Since the beginning of 2014, HPAI H5N8 has been reported from several countries in the Far East; in the Republic of Korea, Japan and China. In the Republic of Korea, countrywide outbreaks have been reported since January 2014 from both commercial and backyard poultry and additional detections in wild waterfowl, resulting in the destruction of over 12 million poultry.

In late autumn of 2014, outbreaks of HPAI H5N8 were reported in four European Union Member States. On 6th of November 2014, Germany has become the first European country to report an outbreak of highly pathogenic avian influenza caused by an A (H5N8) virus genetically similar to one spreading in the Republic of Korea. Genetically similar viruses were found in outbreaks in poultry holdings in the Netherlands, the UK and Italy. It remains unclear how a highly pathogenic avian influenza virus A (H5N8) was simultaneously introduced into closed indoor holdings in different European

countries and different poultry production sectors. Ongoing monitoring and testing of wild birds and domestic poultry in the EU therefore plays an important role in the possible detection of further virus occurrences.

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 such as: infected live animals, contaminated vehicles and products. Therefore, continuous biosecurity measures are important to prevent the spread of virus that, if introduced, could be transmitted to other flocks prior to diagnosis. To combat avian influenza, focus should be on preventive measures that reduce the probability of introduction of the virus into the flock and transmission of virus between poultry flocks.

At the European level, highly pathogenic avian influenza has most commonly been found by the passive surveillance programmes. In contrast, the low pathogenic strains have been detected by active surveillance programmes. Therefore, since 2011, the European Commission 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.

#### REFERENCES

European Commission, ADNS, [http://ec.europa.eu/food/animal/diseases/adns/table\\_11\\_2013.pdf](http://ec.europa.eu/food/animal/diseases/adns/table_11_2013.pdf) OIE - WAHID database.

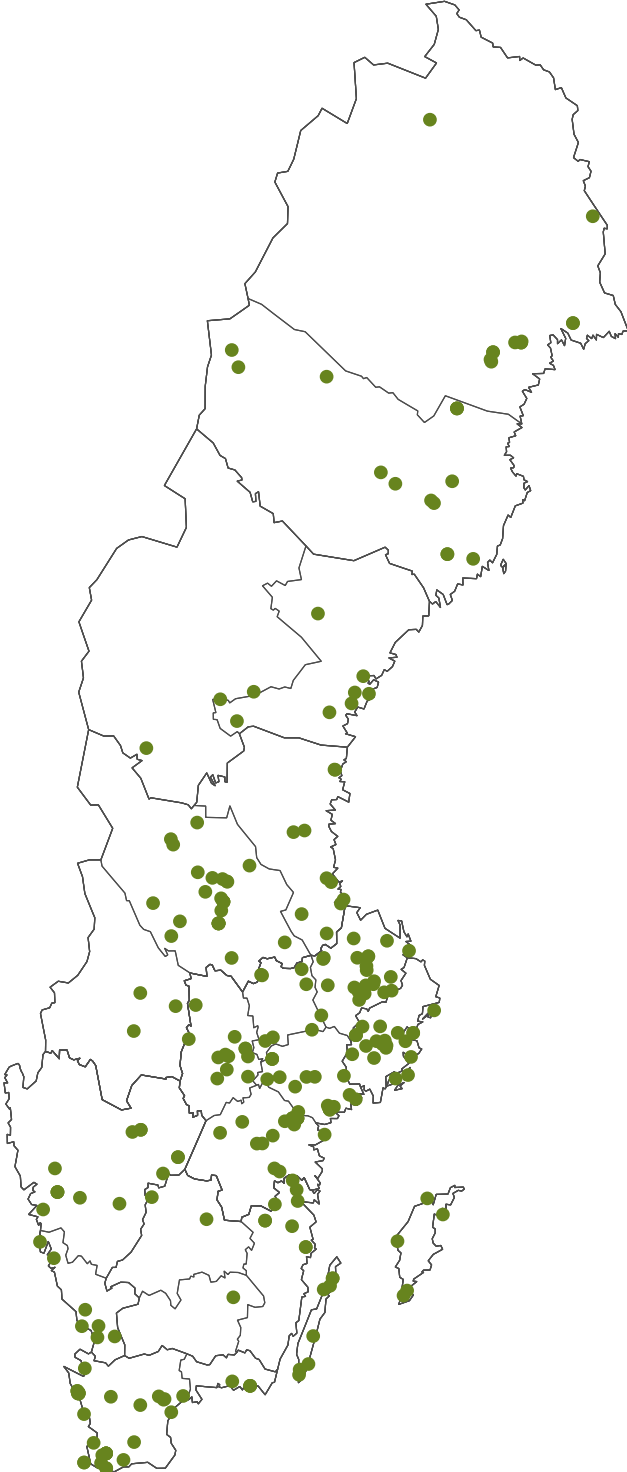


Figure 8: Geographical location of the 263 wild birds analysed for avian influenza in 2014. ©EuroGeographics for the administrative boundaries

Table 6: Number of flocks of different poultry categories sampled in 2006-2014.

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

<sup>A</sup> 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.

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

## 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 pigs by transmission from humans. This reassortant H1N1 virus became known as influenza A(H1N1)pdm09.

### Animals

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

Another swine influenza A type (H1N2) that spread through Europe, was diagnosed for the

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

There has not been a regular monitoring of influenza in pigs in Sweden, but serological screenings were performed in 1999, 2002, 2006 and 2010. At each occasion, 1,000 porcine sera were analysed for H1N1, H3N2 and H1N2. The screening in 2006 also included analyses for



Photo: Bengt Ekberg/SVA

antibodies to H5 and H7. During the past five years, 10-15 herds have been sampled annually with special focus on influenza, in these herds influenza virus has been demonstrated in 3-5 herds per year (Table 7).

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

#### Humans

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

#### LEGISLATION

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

#### SURVEILLANCE

##### Animals

##### *Passive surveillance*

During 2009 to 2014, samples from pig herds with respiratory signs consistent with influenza were collected and analysed for presence of the pandemic influenza A (H1N1)pdm09 virus using a polymerase chain reaction (PCR) method. From each affected herd, 5-10 nasal swab samples were collected and analysed first for swine influenza A and if positive, samples were further analysed for pandemic influenza A(H1N1)pdm09. These samples were also investigated for other influenza A types.

##### *Active surveillance*

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



pling 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).

In 2014 the National Veterinary Institute (SVA) and the Public Health Agency of Sweden (FoHM) initiated a study on the transmission of human and swine influenza among farmers, veterinarians and pigs. In collaboration with the farmer's association, ten field veterinarians were asked to select pig farms that were representative of the pig production systems in Sweden and that were owned by producers interested in participating in the study. All workers on the pig farms with a daily contact with pigs, pig farmers and their families were asked to collect nasal swabs from themselves every second week and whenever they had influenza-like symptoms. Concurrently, samples were collected from the pigs at these farms. Participants were asked to complete a health questionnaire about the type of symptoms, duration of illness, and possible exposures to infected pigs. The participants were also asked if they had been vaccinated against seasonal influenza A viruses.

Starting from first week of February 2014, participating farms were visited every second week for 6 consecutive visits by the field veterinarian. A total of 15 nasal swab samples from pigs were collected at each farm during each visit. During the visit, the age of the pigs and any respiratory clinical signs (absence or presence of sneezing, coughing and nasal secretion) among the sampled individuals was recorded.

The nasal swabs and submission sheets from animals and humans were shipped overnight to the National Veterinary Institute or Public Health Agency of Sweden, respectively.

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

## Humans

In Sweden, every year during the influenza surveillance season 1,500-2,000 samples are collected from patients with influenza like illness (a sentinel surveillance system for influenza). These samples are analysed at the Public Health Agency of Sweden for influenza A and B. If influenza A is detected, further subtyping is performed into A/H1N1pdm09 and A/H3N2. If Influenza A positive sentinel positive samples could not be subtyped, further characterization is performed to rule out zoonotic influenza A. A further 200-300 of the influenza positive samples from the diagnostics laboratory are subtyped/characterized.

Influenza A/H3N2v derives from pigs and has caused outbreaks among humans in USA. Since 2011, 343 human cases, mainly in children, of A/H3N2v have been reported of which 6 cases were during 2014. Influenza A/H3N2 positive sentinel samples from patients below 15 years of age are further analysed for A/H3N2v.

## RESULTS

### Animals

#### *Passive surveillance*

Samples from 18 herds with respiratory signs were analysed for swine influenza virus in 2014. In seven of these herds influenza A virus was detected. Influenza A avian like H1N2 was demonstrated in two of these herds and the pandemic A(H1N1)pdm09 virus was demonstrated in five herds.

#### *Active surveillance*

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

No pigs with clinical disease were observed during the 6 visits to 10 farms as part of the study on the transmission of human and swine influenza among farmers, veterinarians and pigs. In total, 800 swabs were collected from pigs and 246 swabs collected from humans and were analysed for the presence of influenza A viruses. Of these, 74 samples (9%) were positive for influenza A viruses with rRT-PCR. Sixty-nine (93%) of the influenza A positive samples were also positive for pH1.

Out of ten participating farms five farms had

at least one positive result during this period and four farms were tested positive on at least two occasions.

#### Humans

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

As part of the study on the transmission of human and swine influenza among farmers, veterinarians and pigs, 77 samples from veterinarians and 253 samples from farmers were analysed. In April 2014 A/H1N2v was detected in nasal swabs from two pig farmers. Since 2013, a reassortant influenza A(H1N2) virus has been identified in pig population in Sweden. The virus detections in the pig farmers occurred after the same virus had been detected in pigs at the farm where the two of the humans, identified as cases, worked. Both human cases were asymptomatic, and no further human infections have been detected among other farmers or family members. Influenza A subtype H3N2v has not been identified in any sample from humans in Sweden.

#### DISCUSSION

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

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

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

#### REFERENCES

- Kiss, I., A. Bálint, G. Metrevelli, E. Emmoth, F. Widén, S. Bélaç and P. Wallgren (2010). Swine influenza isolated in 1983, 2002 and 2009 in Sweden exemplify different lineages. *Acta Vet Scand.* 52:65.
- Wallgren, P, Paulsson, M. Gerth Löfstedt, M. (2009). Ny influensastam, H1N2, påvisad hos gris i Sverige (Influenza H1N2 demonstrated in Swedish pigs). *Svensk VetTidn.* 61 (14) 11-17.

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

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

# Leptospirosis

## BACKGROUND

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

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

## DISEASE

### Animals

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

### Humans

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

## LEGISLATION

### Animals

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

### Humans

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

## SURVEILLANCE

### Animals

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

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

In domestic pigs, the active surveillance is based on samples collected for the abattoir sampling part of the surveillance carried out by Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS). See chapter on PRRS for details on sampling and population. The surveillance is focused on *L. Pomona* and the surveillance was designed with a between-herd design prevalence of 0.5%, a within-herd design prevalence of 40% and a risk of introduction of 1 in 25 years. Sample size was 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 were 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 2014, 9 cases of *Leptospira* infection were reported in dogs and one in a horse. All cattle tested for export and in breeding centres, were negative for *L. Hardjo*.

No active surveillance was performed in cattle and pigs during 2014. In the active surveillance performed in cattle in 2013, 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 during 2013 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%.

#### Humans

In 2014, six cases of leptospirosis were reported. All the cases had acquired their infections abroad, two in Sri Lanka, one in Afghanistan, one in Colombia, one in Malaysia and one in Namibia. Cases infected outside Sweden have often acquired their infections during leisure activities in contact with water. In 2014, all the cases were

adults from 27 to 56 years of age and all but one were male.

## DISCUSSION

Leptospirosis occurs worldwide, but the predominant serovars vary by geographic region. The disease is associated with reproductive losses in cattle and significant economic costs worldwide. Certain *Leptospira* serovars are present in Sweden. Occasional cases of pigs serologically positive to *Leptospira* spp (other than *L. Pomona*) are diagnosed in Sweden, mostly to an indigenous serovar of *L. Sejroe* (Mouse 2A), *L. Bratislava* and *L. Ichterohaemorrhagiae*. An even lower prevalence to the indigenous strain *L. Sejroe* (Mouse 2A) in cattle has been recorded.

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.

## REFERENCES

- Lindahl E, Boqvist S, Artursson K, Magnusson U, 2011. A field-study on *Leptospira* seroprevalence in dairy cows in four geographical areas in Sweden. *Acta Veterinaria Scandinavica* 53(1), 53.
- Boqvist S, Eliasson-Selling L, Bergström K, Magnusson U, 2012. The association between rainfall and seropositivity to *Leptospira* in outdoor reared pigs. *The Veterinary Journal* 193(1), 135-9.

# 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 1980s outbreaks of listeriosis have been traced to food products.

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

*L. monocytogenes* is destroyed by heating (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 40-120 human cases have been reported annually. Outbreaks have been associated with vacuum-packaged fish (1995-1996) and with cheese made of unpasteurized goat's milk (2001). During recent years, an increasing trend in the number of cases of listeriosis has been noted both in Sweden and internationally. In 2014, 125 cases were reported in Sweden, which is the highest number of cases ever (Figure 9). 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 noninvasive form or as a severe invasive disease. The non-invasive form is mainly febrile gastroenteritis. The severe form most often occurs in immunocompromised persons, newborns, pregnant women and elderly people. Symptoms of invasive listeriosis are septicaemia, meningitis and meningoencephalitis. For those with severe infection, the mortality rate is high (20-40%). The infection can lead to miscarriage, premature delivery or neonatal death. The incubation period of listeriosis varies from 3-70 days, with an average incubation of 21 days.

## LEGISLATION

### Animals

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

### Food

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

### Humans

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

## SURVEILLANCE

### Animals

There is no active surveillance system. Notifications are based on clinical cases and laboratory analyses. The diagnosis can be based on histological findings at necropsy or by detection of the organism by cultivation methods using enrichment in selective broth followed by culture on selective and non-selective agar. Identification is made by biochemical methods. The Swedish Board of Agriculture can decide on epidemiological investigations if needed.

## Food

No official control programme exists. Sampling is performed by national and local authorities, mainly at retail level but also at production units. Sampling performed by the industry is not normally reported to the authorities. Analysis is based on cultivation methods according to EN/ISO 11290-1 and 11290-2 or NMKL 136 or other methods available at accredited laboratories. The ISO-standard is being revised and is expected to be 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 Polymerase Chain Reaction (PCR) to verify molecular serotype and Pulsed Field Gel Electrophoresis (PFGE) for cluster detection.

## RESULTS

## Animals

In 2014, listeriosis was reported in 25 sheep, eight cattle, one horse and in one cat.

## Food

Available results from official sampling by local authorities at food enterprises showed that 519 samples from various food products were analysed and *L. monocytogenes* was detected in 15 of these samples.

## Humans

In 2014, 125 cases of listeriosis were reported (incidence 1.28 cases per 100,000 inhabitants). This is the highest number ever reported and an increase of 34% from the year before (93 cases). The majority of the cases reported in 2014 were elderly people over 70 years and 40% of cases were in people over 80 years of age. Five pregnant women and one infant were reported with listeriosis in 2014. This was an unusual high number when normally 1-2 pregnant women and/or infants are reported every year. Of the reported cases, 53% were women. The counties Jämtland (incidence 3.9), Gotland (3.5), Gävleborg (2.9) and Skåne (2.3) had the highest incidences in 2014. On a ten years average (2005-2014), 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 2014, 116 cases (93%) were reported with Sweden as country of infection. Seven cases were reported as infected abroad and two cases had

missing information about country of infection.

In 2014, all but one (99%) of the human isolates were sent in to the Public Health Institute for typing. The most common molecular serotypes were IIa (83%), IVb (8%), IIb (5%) and IIc (2%).

A large national outbreak of listeriosis occurred between July 2013 and October 2014. A total of 50 cases shared the same serotype, IIa, with identical PFGE pattern and investigations showed that cold cut meat was the suspected source of infection. During the outbreak, isolates with the same PFGE pattern were identified in several products of cold cut meat from one food producer. Despite the fact that the contaminated production line was closed, cases were still reported and the source of infection could never be fully identified. The majority of the outbreak cases (67%) were people over 70 years of age and four pregnant women were infected as part of this outbreak.

A second national outbreak was identified during 2014, between May and September. A total of 17 cases were identified with an identical serotype IIa strain. The PFGE pattern differed from the previous mentioned outbreak strain. As in the previous larger outbreak, the majority of the cases (76%) were in people over 70 years of age. Though investigations pointed toward vacuum-packaged smoked and/or marinated salmon, the source of infection could never be identified. Several food products were analysed but were found negative for *Listeria*. No pregnant women were infected in this outbreak which could indicate that the source of infection was a product that is well-known to be of high-risk and therefore avoided by pregnant women.

## 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 ageing 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 2014 (Figure 9).

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

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

Due to the increasing trend toward cases in vulnerable groups of the population and the two outbreaks during 2013–2014, *L. monocytogenes* is now included in the microbiological surveillance programme at the Public Health Agency of Sweden, and all human isolates are typed without charge. Subtyping is essential for detection of an outbreak cluster of *L. monocytogenes* and for identifying possible links between human and food isolates.

Surveillance of *L. monocytogenes* in humans and in food and food processing environments will be essential for understanding the sources for human infection and giving tools to prevent infections. 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, Na-

tional Food Agency, the Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute.

## REFERENCES

Thisted Lambertz S, Nilsson C, Brådenmark A, Sylvén S, Johansson A, Jansson L-M and M. Lindblad. Prevalence and level of *Listeria monocytogenes* in ready-to-eat foods in Sweden 2010 2012;160:24-31.

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

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

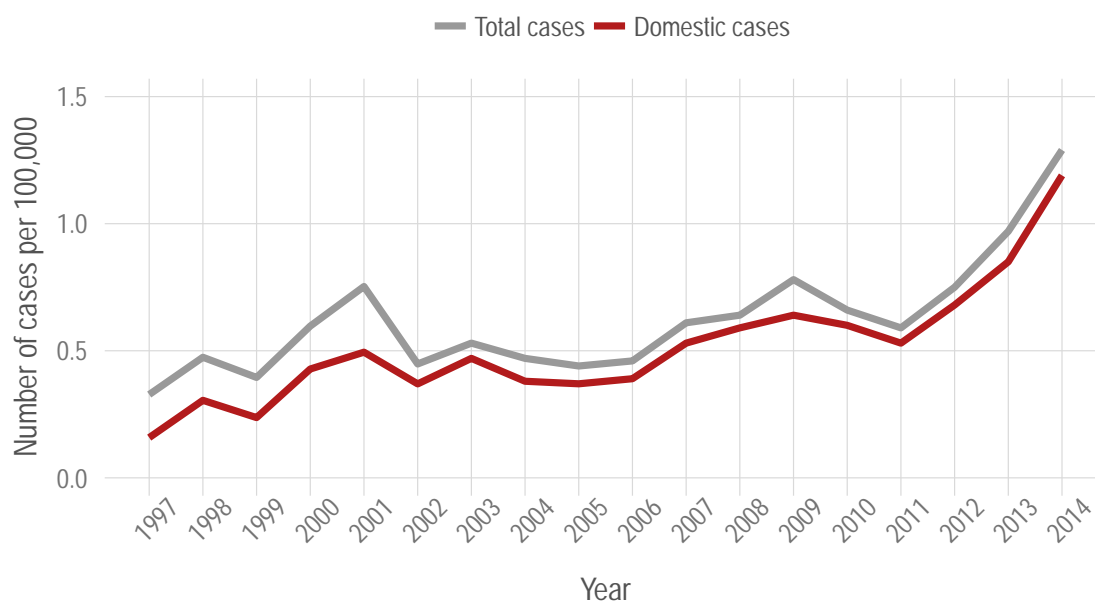


Figure 9: Notified incidence (per 100,000 inhabitants) of human cases of listeriosis in Sweden 1997-2014.

# Maedi-visna



Photo: Bengt Ekberg

## BACKGROUND

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

Data from all affected flocks have been recorded since 1993.

## DISEASE

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

## LEGISLATION

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

## SURVEILLANCE

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



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

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

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

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

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

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

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

## RESULTS

During 2014, 15,600 samples from 594 sheep (and some goat) flocks were analysed in the MV control programme for antibodies against MV virus of which no samples from sheep but samples from one single goat herd were considered positive.

At the end of 2014, 3,279 flocks with 132,157 sheep were declared free from MV corresponding to about 22% of the Swedish sheep population. Approximately 2,100 samples were analysed within the simplified programme, of which 6 herds including 1 goat herd reacted positive.

## DISCUSSION

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

## REFERENCES

Kampen AH, Mork J, Hopp P, Klevar S. The surveillance and control programme for maedi in Norway 2012. Surveillance and control programmes for terrestrial and aquatic animals in Norway. Annual report 2012. Oslo: Norwegian Veterinary Institute 2013

Lindqvist Å. Kontrollprogram hos maedivisna hos får. Svensk veterinärtidning 1993, 11, 463-5

# 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 1,400.0

## DISEASE

### Animals

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

### Humans

The clinical picture is characterized 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 Dis-

ease 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 2014, 418 cases of NE were reported, which was more than a threefold increase compared to the numbers reported in 2013. But at the same time, it was a relatively low incidence in comparison with the two outbreak years, 2006-2007 and 2007-2008 (Figure 10). Most reported cases were in the age category between 40 and 69 years and the median age was 53 years. No cases in children below the age of 5 were reported. Consistent with previous years, more cases were reported in men (63%) than women. The reason for this difference in incidence between age groups and sexes is not completely understood, but behavior is most likely an important factor.

In most years, almost all cases were determined to have acquired their infection in Sweden. In 2014, one case reported having been infected in Russia and one case in Finland, where NE is common.

A majority of the cases (80%) were reported from the four northernmost counties in Sweden. In Jämtland, Västerbotten and Västernorrland the incidence was highest (43-45 cases per 100,000 inhabitants) and in Norrbotten there were 21 cases per 100,000 inhabitants. This regional pattern is consistent with previous years. However, in 2014, there was an unusually high peak in the number of reported cases in August. The incidence also increased during the end of the year.

## 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 conditions impact the rodent populations. In 2014, the number of cases more than tripled com-

pared to 2013, but still they did not yet reach the numbers of the peak years, 2007-2008.

#### REFERENCES

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

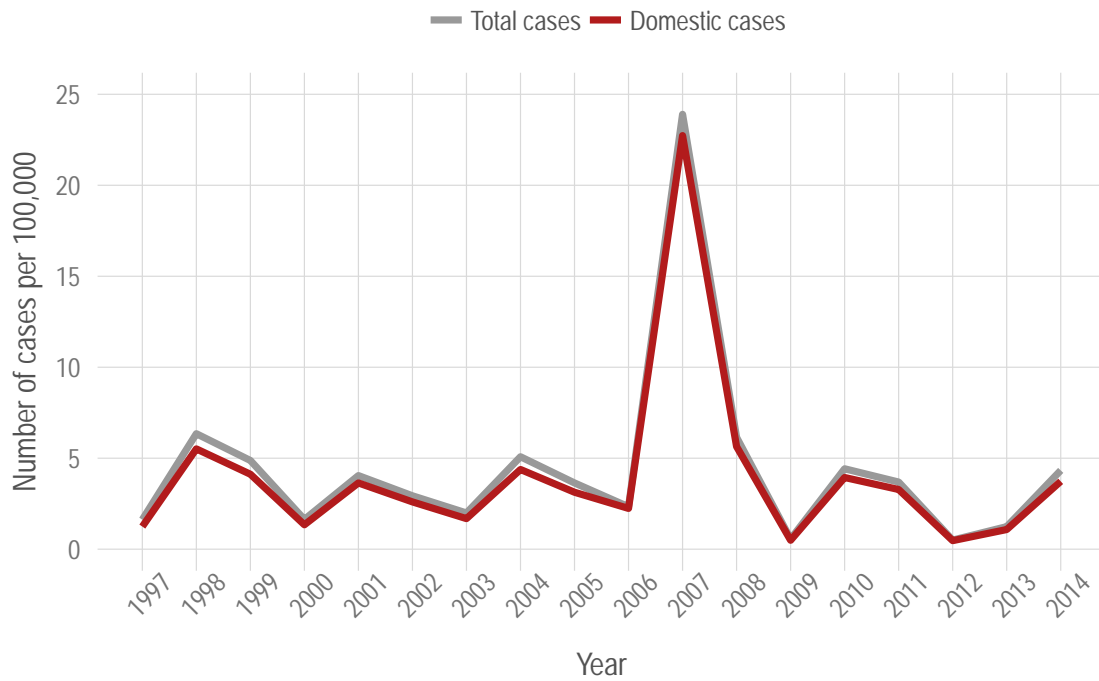


Figure 10: Notified incidence (per 100,000 inhabitants) of human Nephropathia epidemica in Sweden 1997-2014.

# Paratuberculosis



Photo: Bengt Ekberg

## BACKGROUND

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

### Previous active surveillances

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

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

buffalo and camelids.

- Screening of sheep herds during the years 1993- 2011, first with serology, then with faecal culture. The screening of sheep was discontinued in 2012.
- In 2007-2009 screening of beef herds with imported animals during 1990-2005 with faecal culture.
- Screening of older cows at abattoirs in 2009-2010, aimed at a risk group including cows older than six years with signs of weight loss, resulted in 1,211 sampled cows.
- In 2012 screening of beef herds with imported animals during 2005-2011. Herds are investigated by 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 known as Johne's disease, is an intestinal infection in ruminants caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP). The bacteria is excreted in the faeces of an infected animal and the normal transmission route is faecal to oral. It causes chronic diarrhoea and emaciation resulting in suffering and death. The disease causes great economic losses due to reduced milk production, reproductive losses and increased replacements of affected animals.

The incubation period is several years. In areas with endemic infection, clinical disease is most commonly seen at the age of 2-5 years. There is no reliable method to detect the infection 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

Cultures were pre-treated with HPC and double incubation. Samples were subsequently cultured on modified Löwenstein-Jensen medium supplemented with mycobactin and on Herrolds Egg Yolk medium for up to 4 months. Faecal samples from sheep were cultured for up to 6 months, on both modified L-J with mycobactin and modified Middlebrook 7H10 with mycobactin. Direct PCR on a new preparation from the stored samples was performed on samples that had mold overgrowth in the culture.

Samples collected because of clinical suspicion and samples from the beef herd control programme during 2014 were analysed with direct PCR. All tests for MAP were performed at the National Veterinary Institute.

### Passive surveillance

Notification, sampling and diagnostic testing are mandatory in animals of any ruminant species exhibiting clinical signs that lead to suspicion of paratuberculosis. Sampling includes faecal sam-

ples 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 2014 seven animals were investigated due to clinical suspicion of MAP (six cattle and one moose). All were analysed by faecal PCR with negative results.

### Active surveillances

#### *Control programme for surveillance in beef cattle*

In the control programme, the target population is beef herds that sell animals for breeding. The programme is managed by Farm & Animal Health and financed by the Swedish Board of Agriculture. In total, the control programme for bovine paratuberculosis encompassed 447 herds at the end of 2014 including all main breeding beef herds and a smaller number of dairy herds. In 2014, 30 herds were sampled within the programme resulting in 821 individual samples (685 cattle, 127 sheep and 9 water buffalos).

The programme underwent some changes in 2011. In affiliated herds, individual faecal samples are collected annually for three consecutive years, from all cattle over two years of age and all purchased animals from one year of age. 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.

#### *Post mortem examinations*

Sampling was performed on ruminants above one year of age submitted for post mortem examinations. Samples were taken from the ileal wall, ileal contents and ileocaecal lymph nodes and submitted to the National Veterinary Institute. In 2014, 409 animals were sampled; 229 cattle, 154 sheep, 6 goats and 20 exotic ruminants (19 alpacas, and one bison.)

#### *Health controls for export reasons*

Serology is sometimes performed at centres for artificial breeding or in animals for exportation due to requirements in the legislation in the recipient country. Two false positive serologic results was obtained from bulls for export reasons. Both underwent epidemiological investigation and sampling with faecal PCR and was found negative.

## RESULTS

No cases of MAP were detected in any of the examinations carried out in 2014 (Tables 8 and 9).

## 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 species than beef cattle and all cases have been traced back to imported animals with the latest case back in 2005.

Fallen stock is considered a risk category for MAP and therefore all ruminants older than one year of age, submitted for post mortem examination, are sampled for MAP and examined by culture. All herds affiliated with the control programme must send fallen stock for post mortem examination if paratuberculosis cannot be ruled out as a cause for death or culling. The post mortem sampling also includes other susceptible species, like exotic ruminants. The exotic ruminants are sometimes imported, or kept in herds with other exotic ruminants imported from countries where MAP is common.

In a recent study (Frössling, 2013), the probability of freedom and sensitivity of the surveil-

lance 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.

## REFERENCES

Frössling, J, H. Wahlström, E. Ågren, A. Cameron, A. Lindberg, S. Sternberg-Lewerin. Surveillance system sensitivities and probability of freedom from *Mycobacterium avium* subsp *paratuberculosis* infection in Swedish cattle. Preventive Veterinary Medicine, Volume 108, Issue 1, 1 January 2013.

Rockström, U. 2011. Slutrapport; Undersökning avseende paratuberkulos i nötkreatursbesättningar som varit sista besättning till djur, vilka importerats till Sverige under 1990 till 2005. Jordbruksverkets diariernr 33-4861/11.

Sternberg Lewerin, S., E Ågren, J Frössling, G Bolske, A Holmstrom, A Lindberg, E Szanto, D Viske. Control of paratuberculosis in Sweden. In the proceedings of: 9th ICP, Japan, Nov 2007.

Table 8: Screening of sheep and goats.

Surveillance in sheep	No. of sampled sheep	No. of herds
Sheep sampled in cattle herds within the beef herd surveillance programme	114	3
Sampled at post mortem examinations	154	108 <sup>A</sup>

<sup>A</sup> No. of farms where PPN was recorded; six sheep farms had no recorded PPN.

Table 9: Screening of cattle and exotic ruminants.

Surveillance in cattle and exotics	No. of samples	No. of herds
Beef herd surveillance programme <sup>A</sup>	571	25
Sampled cattle at post mortem examinations	229	191
Sampled exotic ruminants at post mortem examinations	20	13

<sup>A</sup> 9 are water buffalo from one herd

# Porcine reproductive and respiratory syndrome

## BACKGROUND

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

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

In 1998, Farm & Animal Health launched a surveillance programme for PRRSV in which the Farm & Animal Health is responsible for the sampling and the National Veterinary Institute performs the analyses. The first case of PRRS in Sweden was confirmed in July 2007. Until then, Sweden was one of few countries that had declared themselves free of PRRSV. The outbreak was detected through the active surveillance programme. Since the disease was not widespread at the time of detection, a decision was made to control the outbreak through a modified stamping out procedure. The actions taken to eradicate the disease proved to be effective and following extensive surveillance during the fall of 2007, Sweden was declared free from the disease with a high probability in the beginning of 2008. Despite extensive investigation, the source of the outbreak could not be established.

After the outbreak in 2007, the surveillance programme was revised in order to enable even earlier detection of an introduction of PRRSV. Another revision of the programme was done in 2012 following extensive changes in the pig production in Sweden.

## DISEASE

Infection with PRRSV causes varying clinical signs depending on the age of the infected animals. The incubation period is 2-7 days (usually 2-3 days) and in adult swine the clinical signs are usually mild, consisting of fever and inappetence for a few days. The devastating effect of PRRSV infection in this category of animals is that it causes reproductive failure including abortions, mummified foetuses, small litters and increased incidence of non pregnant sows. In fattening pigs the infection mainly causes respiratory signs.

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

## LEGISLATION

The disease was included in the Swedish Act of Epizootic Diseases in 1999 (SFS 1999:657 with amendments) 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 (IDEXX PRRS X3 Ab Test, Idexx Laboratories) is used and presence of the viral genome is analysed using a PCR-method. Samples positive for PRRSV antibodies in the ELISA-test are analysed by an immunoperoxidase monolayer assay (IPMA) for confirmation.

### Passive surveillance

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

placed under restrictions.

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

#### 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 between-herd design prevalence of 0.5%, a within-herd design 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% during the year. To reach this level of confidence 5,600 samples, 1,300 from field sampling and 4,300 from sampling at slaughter were needed (based on structure of the pig production and the result of the surveillance in 2013). Ongoing testing of animals for export and at breeding centres adds to the active disease surveillance.

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

## RESULTS

#### Passive surveillance

Four investigations following clinical suspicion of PRRS were completed during 2014. Reproductive failure, neurological signs in piglets and circulatory disorder in sows were the main clinical manifestations and in all herds. 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 foetuses, 29 foetuses from 11 herds were examined for the

PRRSV genome and all samples were negative.

#### Active surveillance

In 2014, 912 samples, from 57 nucleus herds, multiplying herds and sow pools and 2,028 samples from 676 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 10.

Taking the surveillance outcome from 2013 into account, the probability of freedom on a monthly basis during 2014 was 94% and calculated over the year, was >99%.

Approximately 1,400 samples from animals for export and from breeding centres were tested during 2014 and all were negative for antibodies to PRRSV.

## DISCUSSION

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



## REFERENCES

Frössling J, Ågren ECC, Eliasson-Selling L, Sternberg Lewerin S, 2009. Probability of freedom from disease after the first detection and eradication of PRRS in Sweden: Scenario-tree modeling of the surveillance system. *Preventive Veterinary Medicine* 91(2-4),137-45

U. Carlsson, P. Wallgren, L. H. M. Renström, A. Lindberg, H. Eriksson, P. Thorén, L. Eliasson-Selling, N. Lundeheim, E. Nörregård, C. Thörn, M. Elvander Emergence of Porcine Reproductive and Respiratory Syn-

drome in Sweden: Detection, Response and Eradication. *Transboundary and Emerging diseases*. Published Online: Feb 20 2009 10:37AM DOI: 10.1111/j.1865-1682.2008.01065.

Lindberg A, 2008. PRRS-översyn av övervakningsprogrammet. SVA D-nr 2008/429 (In Swedish)

Hultén C, 2012. översyn av den aktiva övervakningen av porcine reproductive and respiratory syndrome (PRRS) i Sverige. SVA D-nr 2012/50 (In Swedish)

Table 10: Number of samples and herds tested in the active PRRS surveillance 2008-2014 in relation to the number of registered swine herds

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

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

# 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 1930s. Since then, outbreaks have been described worldwide.

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

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

## DISEASE

### Animals

Birds commonly develop clinical signs when stressed or when their immune system is suppressed. Clinical signs in birds range from an asymptomatic infection to conjunctivitis, sneezing, pneumonia and 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.



Photo: David Cook Wildlife Photography CC BY 2.0

## 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 2014, *C. psittaci* was detected from one pet parakeet. In addition, eight other pet birds tested negative.

### Humans

In 2014, 12 cases of psittacosis were reported. All of these cases were reported as domestic. Two of the cases were women aged 80 and 84 respectively and 10 cases were men aged 36 to 82 years.

A majority of the cases (n=8) had reported being in contact with birds. The rest of the cases (n=4) had no obvious route of transmission. Most cases (83%) were reported from the south of Sweden during the last quarter of 2014. An outbreak investigation was initiated in December of 2014 when most of the cases were reported. This investigation is still ongoing.

#### 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. De-

tection 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.

#### REFERENCES

- Rehn M, Ringberg H, Runehagen A, Herrmann B, Olsen B, Petersson AC, Hjertqvist M, Kühlmann-Berenzon S, Wallensten A, 2013. Unusual increase of psittacosis in southern Sweden linked to wild bird exposure, January to April 2013. *Euro Surveill.* 18 (19), 20478.
- Blomqvist M, Christerson L, Waldenström J, Herrmann B, Olsen B. *Chlamydia psittaci* in Swedish wetland birds: a risk to zoonotic infection? *Avian Dis.* 2012; 56 (4) :737-40.
- Blomqvist M, Christerson L, Waldenström J, Lindberg P, Helander B, Gunnarsson G, Herrmann B, Olsen B. *Chlamydia psittaci* in birds of prey, Sweden. *Infect Ecol Epidemiol.* 2012; 2.

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

Larger outbreaks of Q fever, when reported, are principally associated with small ruminants, whereas cattle appear to be the source of sporadic cases. In many countries, Q fever is seen as an occupational hazard for professionals in contact with domestic ruminants and their environments, such as farmers, veterinarians and abattoir workers.

The presence of *C. burnetii* in domestic animal populations in Sweden has been known since the early 1990s. The bacterium was first isolated from a sheep placenta in a herd on the isle of Gotland. In 2008/2009, a national survey of dairy cattle herds showed that 8% of the herds were antibody positive in bulk milk. There were large regional differences with the highest prevalence on the isles of Gotland and Öland (59% and 35%, respectively). In 2010, national surveys of sheep and dairy goat herds showed a very low prevalence of antibodies; 0.6% (n=518 herds) and 1.7% (n=58 herds), respectively. In addition, goat bulk milk was also analysed for detection of the agent and *C. burnetii* was not detected. In 2011, 80 sheep farms were investigated for the presence of the agent by analysing vaginal swab samples from sheep taken in conjunction with lambing without detecting the agent in any of the samples. The results supports that *C. burnetii* is a rare pathogen in the Swedish sheep and goat populations. In a survey of 99 Swedish moose during 2008-2010

no positive samples were found, indicating that *C. burnetii* is rare also in this wild species.

In humans, only two domestic cases were reported in the 1980s and 1990s. During the same period, a serological survey in humans identified 28% of sheep farmers and 13% of veterinarians to be antibody positive, indicating a larger extent of the exposure. However, a prospective study on cases of endocarditis showed that only one of 329 patients had antibodies to *C. burnetii* indicating that the chronic Q fever endocarditis is rare. Since Q fever became notifiable in humans in 2004, one to three cases have been reported annually until 2008, when an increase was observed. Only one case was classified as domestic during the period from 2004-2009. In 2010, the situation changed as eight of the totally 11 reported cases claimed to have been infected in Sweden. All these domestic cases were linked to a farm in southern Sweden, which was included in a national survey on dairy herds and where the bulk milk from the cows was shown to be antibody positive for *C. burnetii*.

## DISEASE

### Animals

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

### Humans

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

## LEGISLATION

### Animals

Q fever is a notifiable disease (SJVFS 2013:23). Notification of a primary case of Q fever in animals is based on detection of the agent *C. burnetii* or increased antibody levels in paired samples.

#### Humans

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

#### SURVEILLANCE

##### Animals

There was no active surveillance for *C. burnetii* in 2014. Limited testing was done on cattle and sheep for export reasons. Blood samples from 56 cattle and 44 sheep were analysed for the presence of antibodies by complement fixation test or an indirect ELISA (CHEKIT Q-fever). In total, 7 animals from 3 different herds were tested for Q fever due to clinical suspicion. In addition, one sheep was 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

All 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 2014, two cases of Q fever, both male and both infected in Spain, were reported.

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

#### DISCUSSION

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

#### REFERENCES

ECDC. Technical report: Risk assessment on Q fever. [46 pp] doi:10.2900/28860. Available online: [http://www.ecdc.europa.eu/en/publications/Publications/1005\\_TER\\_Risk\\_Assessment\\_Qfever.pdf](http://www.ecdc.europa.eu/en/publications/Publications/1005_TER_Risk_Assessment_Qfever.pdf)

EFSA Panel on Animal Health and Welfare (AHAW); Scientific Opinion on Q Fever. EFSA Journal 2010; 8(5):1595. [114 pp.]. doi:10.2903/j.efsa.2010.1595. Available online: [www.efsa.europa.eu](http://www.efsa.europa.eu)

# Rabies



Photo: Anders Lindström

## BACKGROUND

Rabies is caused by a lyssavirus in the family *Rhabdoviridae*, and can infect all warm-blooded animals. The disease occurs worldwide with some exceptions. Rabies is transmitted through contact with saliva, typically via animal bites. Most human cases are caused by bites from infected dogs. The reservoir animal species for rabies in endemic countries are 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 SJVFS 2014:47 and in the EU Regulation 576/2013.

Humans

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

## SURVEILLANCE

### Animals

#### *Passive surveillance*

Four dogs and one red fox 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.

Four dead or wounded and euthanized bats were sent to the National Veterinary Institute (SVA) for rabies examination. The diagnostic methods used were based on PCR. The bats were sent to the Swedish Museum of Natural History, Stockholm, to determine the species.

#### *Active surveillance*

Illegally imported pets, from countries with endemic rabies, that are detected and euthanized are examined for rabies to exclude the possible spread of rabies in Sweden. During 2014, 31 dogs and 1 cat were examined after a decision by the Board of Agriculture. The diagnostic method used was PCR. None of the animals had presented clinical signs associated with rabies.

### Humans

The surveillance in humans is passive.

## RESULTS

### Animals

All animals tested negative for rabies.

### Humans

No human cases were reported during the year.

## DISCUSSION

During the recent decades, two people have been hospitalised for rabies in Sweden. In 1974, a Swedish man fell ill after having been infected

in India. In 2000 a woman fell ill after a visit to Thailand. Both patients had most probably been infected by rabid dogs. Since Sweden is free from classical rabies, the risk of acquiring the disease from Swedish animals is negligible. There has been an increasing problem with illegal importation of pets since 2004, mostly dogs. Illegally imported dogs from endemic countries are probably the greatest threat to the rabies free status of Sweden. During 2014, SVA made a new risk assessment on rabies. The results suggest that the probability of introducing rabies with illegally imported pets is very low, but not negligible. The results are similar to the results from 2005.

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

Antibodies to EBLV have been detected in specimens from live Daubenton's bats as part of the active surveillance programme, suggesting that EBLV is present in Sweden. Daubenton's 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 19 different species of bats in Sweden, all insectivorous belonging to the family of Vespertilionidae.

# 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 all parts of the production chain, from feed to food of animal origin. When Sweden joined the European Union in 1995, the Swedish *Salmonella* control programme was accepted.

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

## DISEASE

### Animals

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

### Humans

*Salmonella* infects the gastrointestinal tract and causes an acute gastrointestinal illness. The symptoms can range from asymptomatic and mild to severe. The incubation period is typically between 1 and 3 days but can vary from 6 hours to 10 days. Most patients recover from the illness spontaneously but sequelae such as reactive arthritis occur in approximately 1-15% of the patients. Moreover, prolonged symptomless excretion of the pathogen is common.

## LEGISLATION

### Feed

Control of animal feed is an integrated and essential part of the control programme for *Salmonella* at farm level. The feed business operator is responsible for producing *Salmonella*-free feed. Poultry feed must be heat treated according to the legislation. The majority of cattle and pig feed is also heat-treated. The control of feed is supervised by the Swedish Board of Agriculture which carries out announced and unannounced inspections at feed mills. *Salmonella* in feed is regulated in national legislation (SJVFS 2006:81) as well as in an EU regulation (Commission Regulation (EU) No142/2011).

### Animals

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

### Food

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

### Humans

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

## SURVEILLANCE

### Feed

In the control programme for feed, the emphasis is on control of feed raw materials, the heat treatment process and preventive measures for preventing 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 feed mills manufacturing compound feeding stuffs for poultry and a minimum of two samples from those manufacturing compound feeding stuffs for other food-producing animals must be collected in the processing line on a weekly basis. These samples are analysed at National Veterinary Institute (using MSRV, amendment to ISO 6579:2002 Draft 251004) and any finding of *Salmonella* is reported to the Swedish Board of Agriculture. The manufacturers also take additional 'own control' samples from the processing line and the feed mill environment.

## Food

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

Official sampling by local authorities at food enterprises, other than abattoirs and cutting plants, is at a level of approximately 800 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 5,000 samples are taken annually from crushed meat and meat scrapings and approximately 900 samples are taken in poultry meat cutting plants. The samples are analysed by regional laboratories using the current edition of the NMKL (nr 71:1999) method, with the exception of approximately 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 with more than 250 birds are tested (Table 11). Grandparents of *Gallus gallus* broilers are imported as day-old chicks. Laying hens, turkeys, geese and ducks are imported as parents. Samples consist of sock samples taken from all parts of the house where the birds are kept. From rearing flocks, two pairs of sock samples are taken and pooled into one, five pairs pooled to two are taken from production flocks of breeders.

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

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

*Voluntary programme - poultry*

A preventive voluntary programme includes all-in all-out production, hygienic measures and a high standard for poultry houses, such as hygienic barriers between the clean and unclean part. Purchases of animals may only occur from holdings affiliated to the voluntary programme and only heat-treated feed is allowed. The poultry houses

must be cleaned and disinfected before introduction of a new flock. The broiler producer has to make an application to be accepted into the voluntary programme. An official veterinarian inspects the housing regularly. The producers affiliated to the voluntary programme receive higher compensation in case of *Salmonella*. All broiler producers belonging to the Swedish Poultry Association are affiliated to the voluntary programme (approximately 99% of the slaughtered broilers). The voluntary programme has been in place for more than 40 years. 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. *Salmonella* is tested at other post-mortem investigations if an infection is suspected by macroscopic findings. All imported animals are sampled. On clinical suspicion, herds or single animals should be tested for *Salmonella*.

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

#### *Control in other animals*

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

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

#### Humans

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

## MEASURES IN CASE OF POSITIVE FINDINGS

### Isolates

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

### Feed

Findings of *Salmonella* in intra community traded or imported feed materials and compound feeds are reported in the Rapid Alert System for Food and Feed (RASFF). Measures are always taken when *Salmonella* is detected in feed samples. *Salmonella* positive feed materials are usually treated with organic acids. After acid treatment the feed material has to be re-tested negative before use in feed production. Finished feed containing *Salmonella* has to be withdrawn from the market. Extended sampling and cleaning are done in the production line if *Salmonella* is detected in the weekly surveillance. If *Salmonella* is found before heat treatment the contaminated part of the production line is thoroughly cleaned and disinfected, usually by dry cleaning, followed by disinfection. If *Salmonella* is found after heat treatment, the feed mill has to be thoroughly cleaned and disinfected. Environmental sampling must show negative results before production is resumed.

### Animals

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

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

All *Salmonella* positive poultry flocks are destroyed irrespective of serovar. The poultry house and all possible contaminated areas are thoroughly cleaned and disinfected. Before in-

roduction of new birds, all environmental samples must be negative for *Salmonella*.

In pigs and cattle, a combination of partial herd depopulation and hygienic measures controlled by repeated sampling is usually practiced. Cattle herds that are under restrictions for *Salmonella* are monitored by a combination of serological and bacteriological testing. Hygienic measures can include reducing the number of animals, control of animal feed and manure movements on the farm and reduction of *Salmonella* in the environment by cleaning and disinfection. No *Salmonella* positive animals should enter the cleaned and disinfected parts of the stable. Negatively tested animals, when considered at low risk of being infected, may be slaughtered under certain conditions with extra hygienic measures and sampling of each carcass. The restrictions are lifted when the cleaning and disinfection have been completed and *Salmonella* cannot be detected 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. However with one exception which is *Salmonella diarizonae* serovar 61:(k):1,5(7) in sheep meat, which is not considered unfit for human consumption, (§§ 30a-30b, LIVFS 2005:20 with amendments).

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

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

## RESULTS

### Feed

Eleven major feed mills produce approximately 95% of the feed for food producing animals. In the weekly surveillance of feed mills, 9,526 sam-

ples were analysed for *Salmonella* with 31 samples (0.33%) positive. Sixteen serovars were detected; *S. Typhimurium* was the most common (n=8) (Table 14).

In addition, *Salmonella* was detected in 14 out of 1,391 analysed batches from feed materials of vegetable origin. The most common serovar was *S. Agona* (n=7). *Salmonella* was detected in three environmental samples from domestic rapeseed processing plants. *Salmonella* was detected in 13 out of 1,162 batches from feed materials of animal origin and from pet food.

### Animals

#### Poultry

*Salmonella* was detected in two flocks (0.06%) of 3,276 broilers in routine sampling before slaughter (Table 13). In addition, *S. Poona* was detected in one parent flock (Table 13 and Figure 17). Also, *Salmonella* was detected in two (0.31%) of 646 flocks of layers. *Salmonella* was also detected in two goose flocks. *Salmonella* was not detected in flocks of turkeys or ducks.

#### Cattle

In summary, *Salmonella* was detected in nine new herds in 2014 (Table 15);

- 2 herds were detected by post mortem examination of a diseased calf.
- 3 herds were detected in a bulk milk screening performed in an area of the Skåne county, where a prolonged *Salmonella* outbreak has been occurring since 2012.
- 3 herds were detected by trace-back investigations from a *Salmonella* positive herd.
- 1 herd was detected by sampling before sale

In addition, *Salmonella* was isolated from eight farms put under restrictions before 2014.

*Salmonella* was not isolated from any of 3,756 mesenteric lymph nodes from cattle at slaughter (Table 12 and Figures 13 and 14).

#### Pigs

In 2014, *Salmonella* was not detected in any of the pig herds sampled (Figure 15).

*Salmonella* was neither detected from any of 2,329 lymph node samples taken from adult pigs (Table 12 and Figures 13 and 14) nor from the 2,871 lymph node samples from fattening pigs (Figures 13 and 14).

*Other animals*

In 2014, *Salmonella* was detected in 121 cats (Table 16). Most of these were reported from January to May. All the 32 serotyped cat isolates belonged to Typhimurium.

An outbreak of *Salmonella* among hedgehogs on the island of Gotland in 2013 led to an intensified screening of *Salmonella* among hedgehogs in 2014. This resulted in findings of Enteritidis in 16 hedgehogs. In addition, *Salmonella* Typhimurium was detected in two hedgehogs from mainland Sweden. Also, *Salmonella* was detected in two dogs, one horse, 14 wild birds and eleven other wild mammals than hedgehogs (Table 16).

## Food

In the Swedish *Salmonella* control programme, *Salmonella* was not detected in any of the 3,742 cattle carcass samples and not in any of the 5,232 pig carcass samples (Table 12). *Salmonella* was not isolated from any of the 4,435 poultry neck skin samples or 6,155 samples from cutting plants (Table 12 and Figures 13 and 14).

Available results from official sampling by local authorities at food enterprises showed that 805 samples for *Salmonella* were taken for reasons other than the *Salmonella* control programme. Three of these 805 samples were positive.

## Humans

In 2014, a total of 2,213 cases of salmonellosis were reported, compared to 2,838 cases in 2013 (Figure 12). Domestic cases decreased by 16%, from 651 cases in 2013 to 547 cases in 2014, an incidence of 5.6 cases per 100,000 inhabitants.

A majority of the cases (75%) were infected abroad. However, travel-associated cases decreased to 1,634, a decrease of 24% compared to 2013. Since 2009, a steep decrease in the number of travel-associated cases has been noted, despite an increase in international travel. Travel-related cases have decreased since the early 2000s. The fewest travel-associated cases were recorded during the years 2011-2013. The observed decrease has been most apparent among those travelling in Europe. As in previous years, *Salmonella* infection was most commonly acquired in Thailand (350 cases) followed by Turkey (280), Spain (121), Tanzania (48), Egypt (46) and India (41).

Among the domestic cases, the median age was 40 years (0-92 years). Children aged 0-10 years accounted for 15% of both the domestic and the travel-associated cases. The gender distribution was even among the domestic cases but slightly less women than men (48 %) were re-

ported among the travel-associated cases.

A total of 91% (499 cases) of the isolates from domestic cases were serotyped compared to 15% of the travel associated cases. *S. Typhimurium* was the most common serovar in domestic isolates (23%) followed by *S. Enteritidis* (19%) and monophasic *S. Typhimurium* (*S. enterica* sp. *enterica* 1,4,[5],12:i:-) (14%). Phage types 8, 1, 21, 4 and 14b were most common among the domestic isolates of *S. Enteritidis*. During 2013, phage typing of *S. Typhimurium* was completely replaced by MLVA (multi-locus variable number tandem repeat analysis). Of the domestic isolates of *S. Typhimurium*, MLVA profile 4-8-14-11-211 (12 isolates) was the most common, followed by 3-14-11-N-311 (10 isolates). MLVA profile 3-12-9-N-211 (26 cases) was the most common among domestic isolates of monophasic *S. Typhimurium*. *S. Enteritidis* accounted for 40% of the isolates typed from travel-associated cases. In Sweden, Typhimurium is the most common domestic serovar, whereas in most other European countries Enteritidis is the most common one.

A clear seasonal variation of *Salmonella* cases was observed with most cases during the summer months. In 2014, an increase in notified cases was seen from July to September. Most travel-associated cases were reported from January to March when travelling to warmer destinations is common. Also, a clear peak travel-associated cases was noted during the summer months when many people have vacation.

During 2014, eight small domestic outbreaks of *Salmonella* were reported. Most of the outbreaks were detected as a rise in cases of a particular serovar or a specific MLVA-profile. Cases in most outbreaks were spread in the country. Therefore, outbreak investigations were challenging and, unfortunately, the source could seldom be identified. In July 2014, a cluster of *S. Typhimurium* cases (n=6) with an MLVA-profile 3-14-11-N-311 was seen in a group of people who all had eaten at the same shopping mall. Further investigation resulted in suspicion that the source of the infections was a stir-fried chicken dish. Samples were taken from the chicken meat, but instead of *S. Typhimurium* two other serovars: *S. Give* and *S. Albany* were found in the meat. In August 2014, an outbreak of 8 cases of *S. Montevideo* was detected. All the cases had eaten a salad at the same restaurant. Cantaloupe was suspected to be the source but could never be confirmed.

## DISCUSSION

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

In the feed sector, data from 2014 showed that *S. Typhimurium* was the most frequently isolated serovar in the weekly surveillance of feed mills. This serovar was detected in 8 samples, most from one major feed mill. This feed mill has struggled, in the past, with contamination of *S. Typhimurium* in the vicinity of the production line. The company solved this specific problem in 2012, but continues to occasionally detect *S. Typhimurium* in the feed mill environment.

Since 2012, an outbreak of *Salmonella* Dublin has been ongoing in cattle herds in the county of Skåne. The source of this infection has not yet been identified. In 2012, the pathogen was detected in two herds, the year after in another three herds and in 2014 in seven new herds. All but one of these infected herds are located within a radius of 10 km, in a cattle dense area of Skåne (Figure 11). The only infected herd outside this region had purchased cattle from one of these herds. An intensified screening of *Salmonella* has been implemented in this area.

During 2013 and 2014, *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.

In 2014, *Salmonella* was not detected in any of the samples taken at the abattoirs or cutting plants. However, in 2014, a new laboratory was chosen to perform *Salmonella* analyses for the control programme. This laboratory is accredited for *Salmonella*, but had only a limited experience with *Salmonella* and no experience with the sample types that are collected in the control programme: lymph nodes, carcass swabs and meat

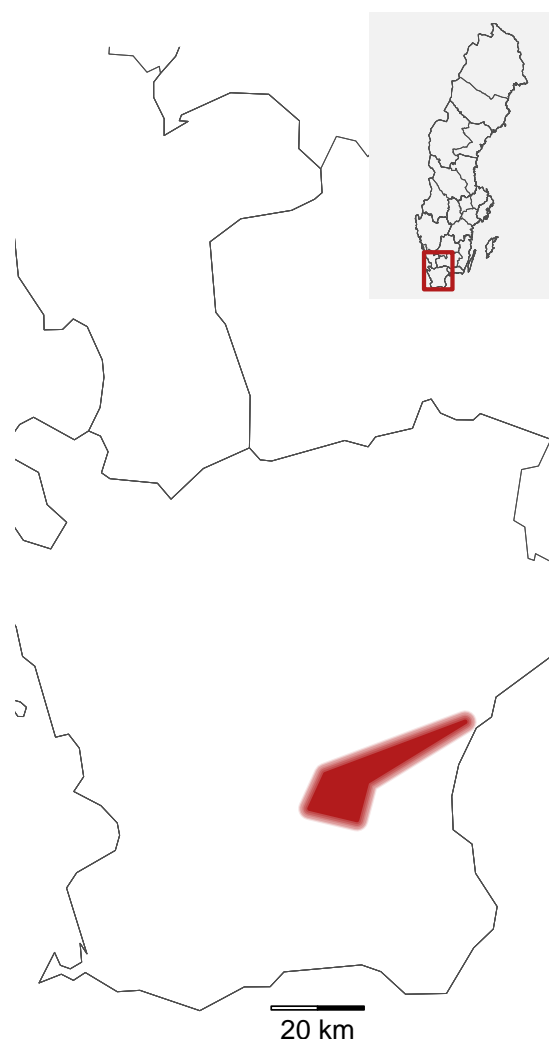


Figure 11: Zone that includes the 12 cattle herds that are part of the ongoing outbreak of *S. Dublin* in the county of Skåne. ©EuroGeographics for the administrative boundaries

trimmings. The National Reference Laboratory (NRL) for *Salmonella* inspected the laboratory and found that the analytical methods and laboratory routines needed improvement. The National Food Agency and NRL recommended measures the laboratory needed to take to improve its performance. The implementation of these improvements was in progress at the end of the year 2014.

Reported domestic human cases of *Salmonella* vary from year to year depending on the number of outbreaks. The total number of notified human cases decreased significantly from 1997-2009, but this decreasing trend could not be identified for the domestic cases. The largest de-

crease was seen for the travel-associated cases, especially from European countries. This decrease in *Salmonella* cases has been seen in countries throughout the EU and is considered to be the result of the implementation of the harmonised *Salmonella* control programmes in poultry.

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

Investigations of the domestic *Salmonella* outbreaks were challenging and did not lead to the confirmation of any sources of infection. One difficulty was that, sampling delay when tracing the potential source of an outbreak, resulted in a suspected batch often no longer being on the market.

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

Pulsed-field Gel Electrophoresis (PFGE) is another molecular tool that has been successfully applied in outbreak investigations.

Routinely subtyping isolates of *S. Typhimurium* from humans by MLVA subtyping allows for the comparison with subtyped isolates from animals, food, feed and the environment. This strategy, has proven to be useful to detect clusters and outbreaks. PFGE has been used for typing of non-Typhimurium isolates and has also resulted in connecting cases to sources and outbreaks.

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

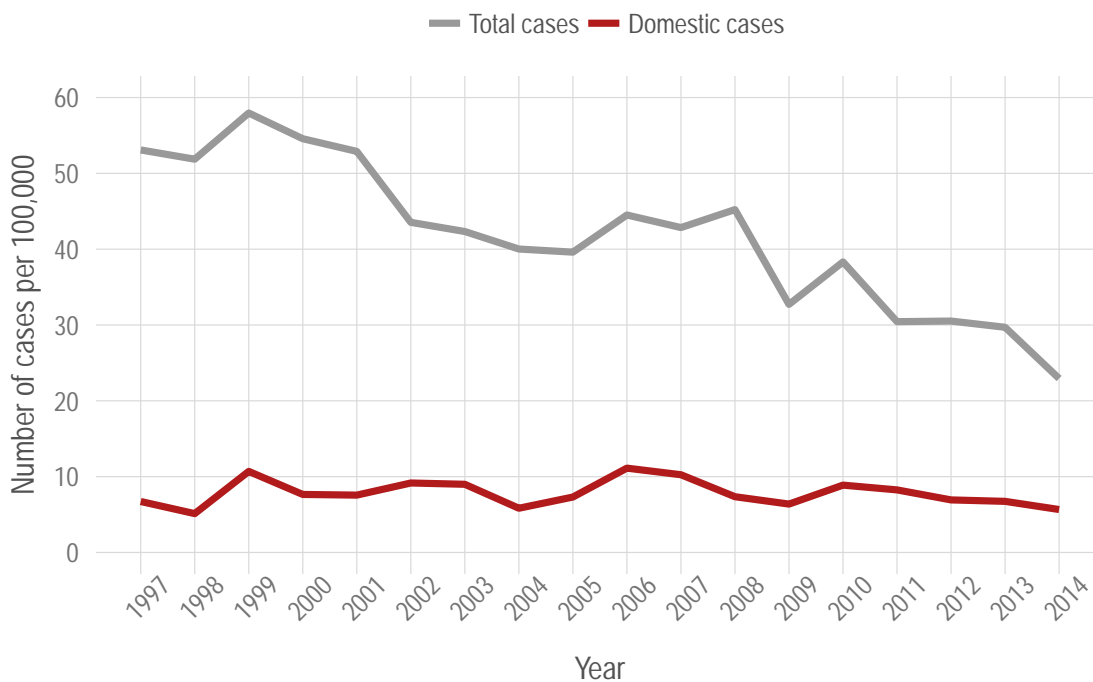


Figure 12: Notified incidence (per 100,000) of human salmonellosis in Sweden, 1997-2014.

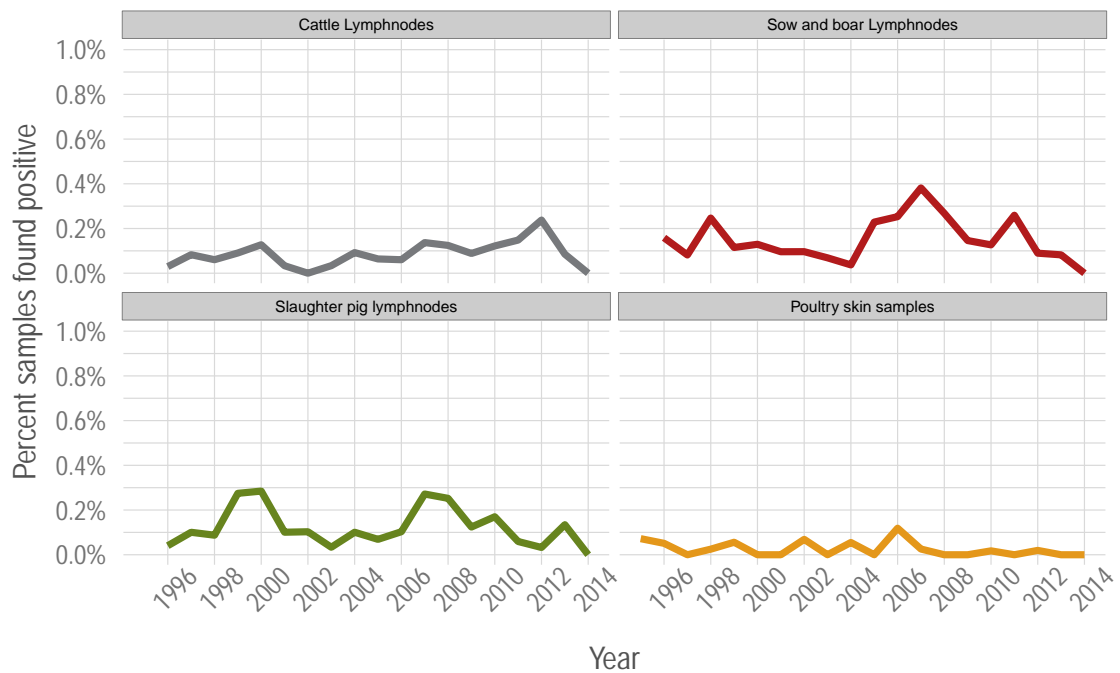


Figure 13: *Salmonella* found in lymph node samples from cattle, sows and boars and fattening pigs sampled at major slaughterhouses as well as neck skin samples from poultry at all slaughterhouses. In 2014, 0 samples from cattle, 0 from sows and boars, 0 fattening pigs, and 0 poultry neck skin samples were *Salmonella* positive.

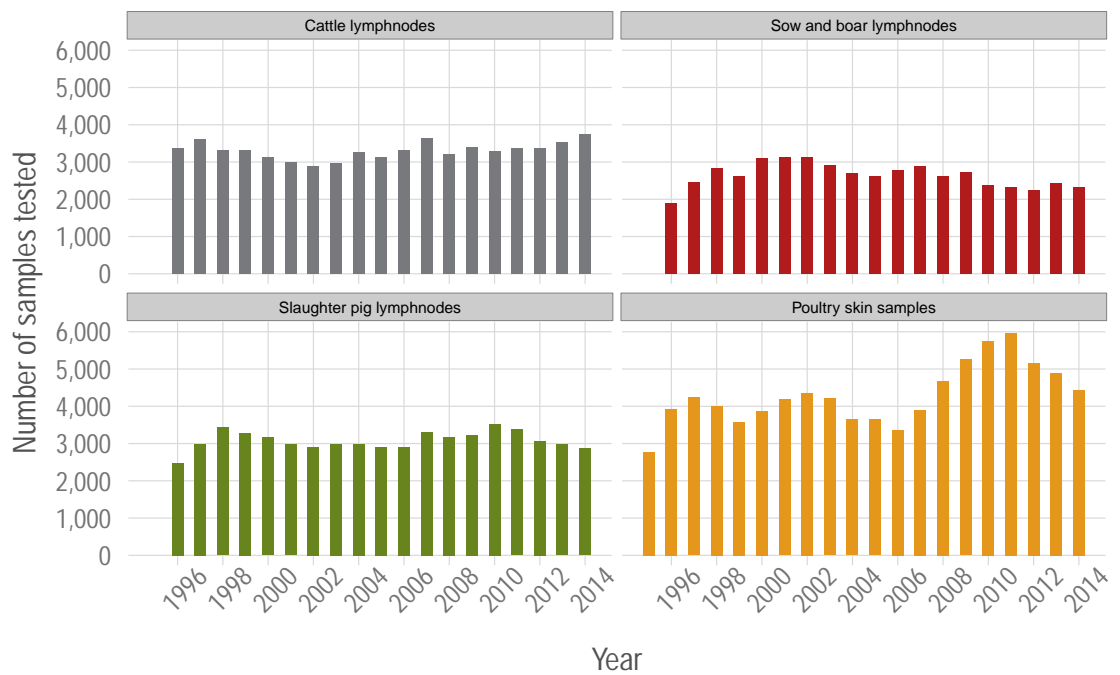


Figure 14: The number of lymph node samples from cattle, sows and boars and fattening pigs sampled at major abattoirs as well as the number of neck skin samples from poultry sampled at all abattoirs. In 2014, 3,756 samples from cattle, 2,329 from sows and boars, 2,871 from fattening pigs, and 4,435 poultry neck skin samples were tested for *Salmonella*.

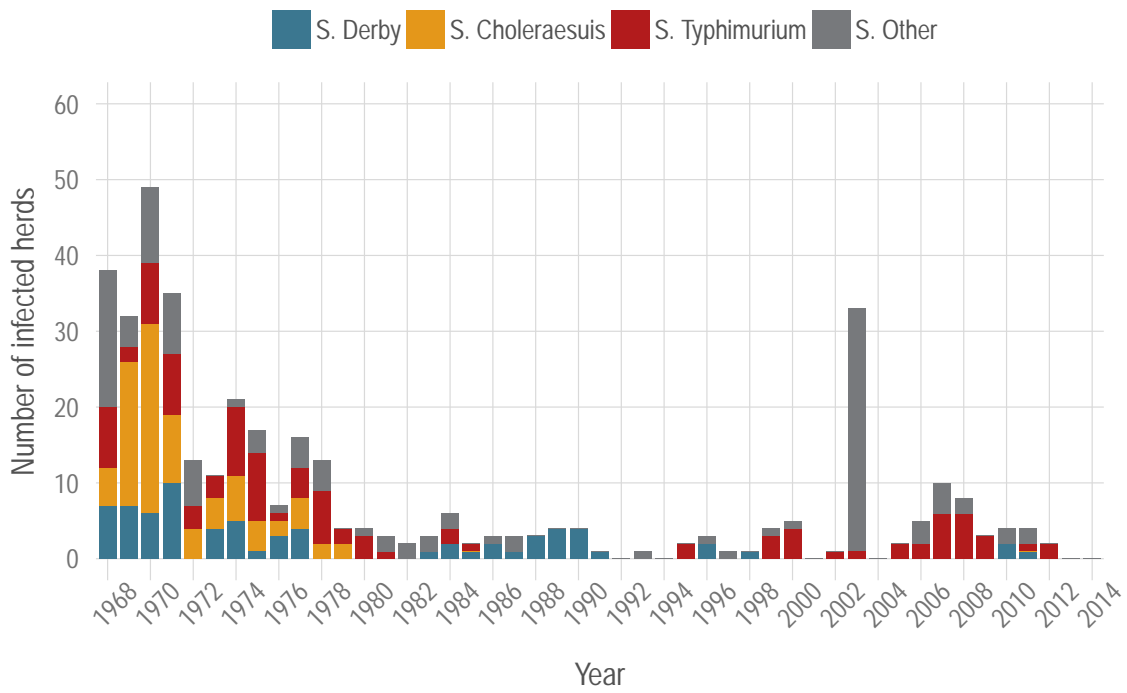


Figure 15: Incidence of *Salmonella* in swine herds during 1968-2014.

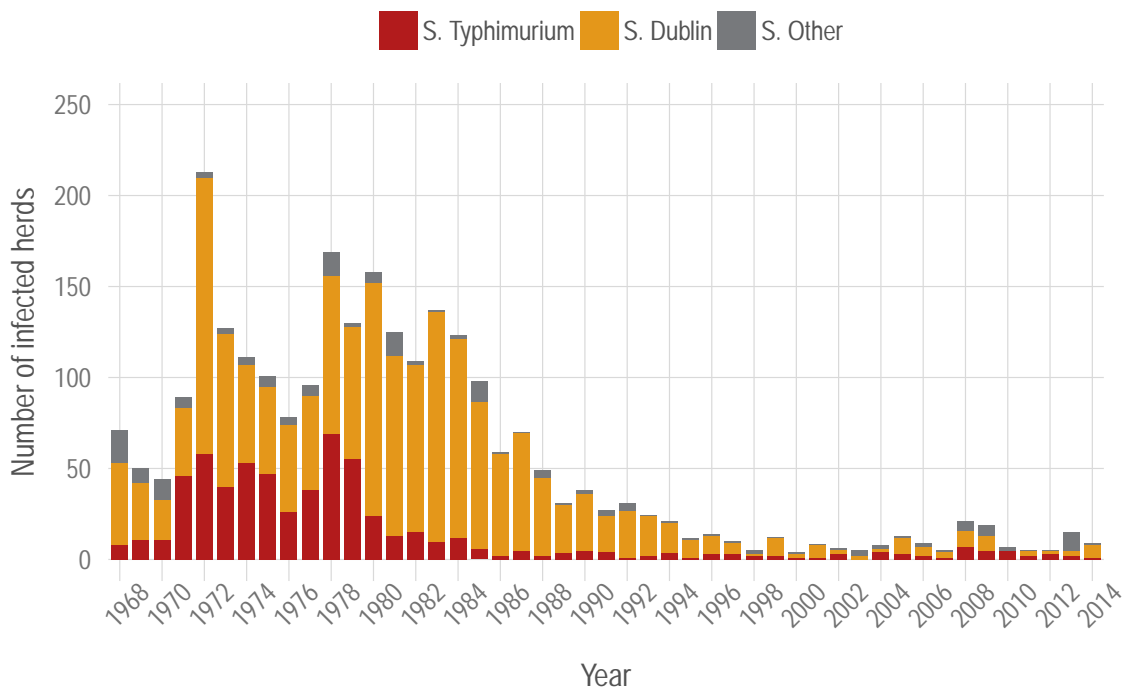


Figure 16: Notified incidence of *Salmonella* in Swedish cattle herds during 1968-2014.



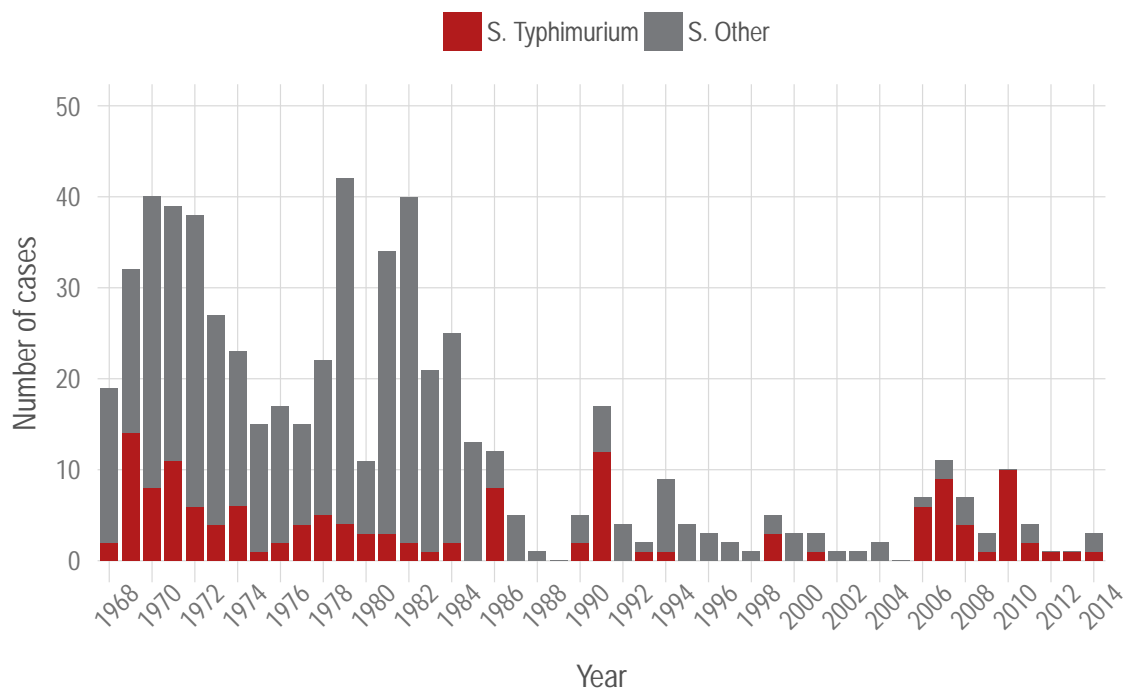


Figure 17: Notified incidence of *Salmonella* in broiler holdings during 1968-2014, breeding flocks included.

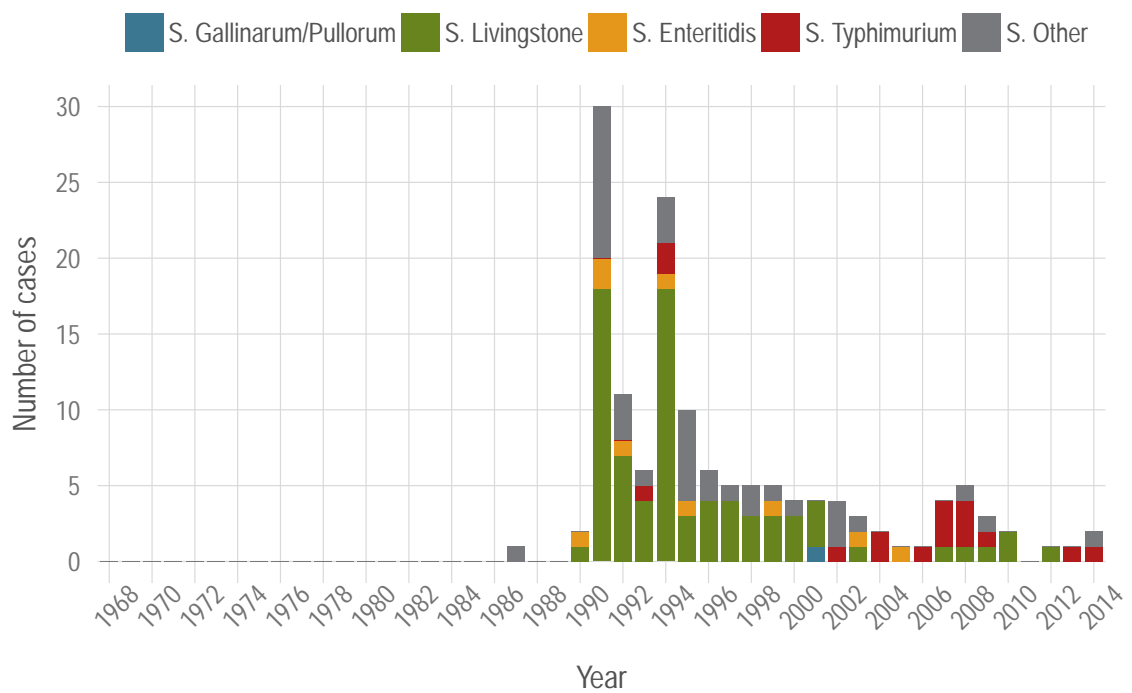


Figure 18: Notified incidence of *Salmonella* in layer holdings during 1968-2014.

DISEASE SURVEILLANCE 2014

Table 11: Sampling scheme of poultry

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

Table 12: Results from the *Salmonella* control programme at slaughterhouses and cutting plants in 2014

Animal species	Sample type	No. samples	Positive
Cattle	Lymph node	3,756	0
	Carcass swab	3,742	0
Breeding swine	Lymph node	2,329	0
	Carcass swab	2,365	0
Slaughter swine	Lymph node	2,871	0
	Carcass swab	2,867	0
Cattle and swine	Meat scrapings	4,530	0
Poultry	Neck skin	4,435	0
	Meat scrapings	874	0

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

Animal species	Production type	Production stage	No. flocks tested	No. positives	Percentage	Serotype
<i>Gallus gallus</i>	Meat production	Adult Grand Parent	17	0	0.00%	
<i>Gallus gallus</i>	Meat production	Adult Parent	130	1	0.77%	<i>S. Poona</i>
<i>Gallus gallus</i>	Meat production	Production	3,276	2	0.06%	<i>S. Typhimurium</i>
Turkeys	Meat production	Adult Parent	4	0	0.00%	
Turkeys	Meat production	Production	164	0	0.00%	
<i>Gallus gallus</i>	Egg production	Adult Parent	12	0	0.00%	
<i>Gallus gallus</i>	Egg production	Production	646	2	0.31%	<i>S. Mbandaka, S. Typhimurium</i>
Geese <sup>A</sup>	Meat production	Production	31	2	6.45%	<i>S. Typhimurium</i>
Ducks <sup>A</sup>	Meat production	Production	42	0	0.00%	

<sup>A</sup> Number of slaughter batches

Table 14: Serotypes of *Salmonella* isolated in feed control in 2014

Serotype	Feed material of animal origin <sup>A</sup>	Pet food	Feed material of oil seed origin <sup>B</sup>	Feed material of cereal grain origin	Process control feed mills	Process control rapeseed crushing plant
<i>S. Agona</i>	-	-	7	-	3	-
<i>S. Bareilly</i>	-	-	-	-	1	-
<i>S. Binche</i>	-	-	-	-	1	-
<i>S. Blockley</i>	-	2	-	-	-	-
<i>S. Bredeney</i>	-	1	-	-	-	-
<i>S. Chennai</i>	-	-	1	-	-	-
<i>S. Cubana</i>	-	-	-	-	1	1
<i>S. Duesseldorf</i>	-	-	-	-	1	-
<i>S. Emek</i>	-	-	-	-	1	-
<i>S. enterica</i> subsp.	1	-	-	-	2	-
<i>S. Glostrup</i>	-	-	-	-	1	-
<i>S. Havana</i>	-	-	-	-	1	-
<i>S. Infantis</i>	-	-	2	-	-	-
<i>S. Kapemba</i>	1	-	-	-	-	-
<i>S. Kedougou</i>	-	-	1	-	1	-
<i>S. Lamberhurst</i>	2	-	-	-	-	-
<i>S. Mbandaka</i>	-	-	1	-	3	2
<i>S. Montevideo</i>	-	-	-	-	1	-
<i>S. Ohio</i>	1	-	-	-	-	-
<i>S. Potsdam</i>	-	1	-	-	-	-
<i>S. Putten</i>	-	-	-	-	1	-
<i>S. Rissen</i>	-	-	-	2	1	-
<i>S. Ruiru</i>	-	-	1	-	3	-
<i>S. Senftenberg</i>	-	1	-	-	1	-
<i>S. Tennessee</i>	2	-	-	-	-	-
<i>S. Typhimurium</i>	2	-	-	-	8	-
<b>Total Positive</b>	9 <sup>C</sup>	5	13 <sup>D</sup>	2	31	3
<b>Total number of samples</b>	965	197	1,058	333	9,526	816

<sup>A</sup> Meat and bone meal, fish meal, greaves, bone meal, protein meal, meat meal, blood products, milk products, and poultry offal meal.

<sup>B</sup> Derived from palm kernel, rape seed, soya bean and sunflower seed.

<sup>C</sup> 8 positive samples, two different serotypes in one sample.

<sup>D</sup> 12 positive samples, two different serotypes in one sample.

DISEASE SURVEILLANCE 2014

Table 15: Cattle herds under restrictions for *Salmonella* infection in 2014

Primary serotype	Restricted since	Restrictions lifted	Reason for sampling
S. Dublin	2008	-	Necropsy
S. Dublin	2012	-	Trace-back
S. Dublin	2012	-	Necropsy
S. Dublin	2013	-	Trace-back
S. Dublin	2013	-	Trace-back
S. Dublin	2013	-	Necropsy
S. Dublin	2014	-	Necropsy
S. Dublin	2014	-	Trace-back
S. Dublin	2014	2014	Trace-back
S. Dublin	2014	-	Trace-back
S. Dublin	2014	-	Trace-back
S. Dublin	2014	-	Trace-back
S. Dublin	2014	-	Trace-back
S. Dublin	2014	-	Trace-back
S. Infantis, S. Typhimurium	2014	2014	Sampling before sale
S. Mbandaka	2013	-	Tracing contaminated feed
S. Typhimurium	2013	-	Sampling before sale
S. Typhimurium	2014	-	Necropsy

Table 16: Reported cases of *Salmonella* in cats, dogs, horses, wild mammals and wild birds in 2014

Serotype	Cats	Dogs	Horses	Badgers	Bears	Hedgehogs	Lynx	Moose	Otters	Wolves	Wild birds
S. Derby	-	1	-	-	-	-	-	-	-	-	-
S. Dusseldorf	-	-	-	-	-	-	-	-	-	2	-
S. Enteritidis	-	-	-	-	-	16	-	-	-	-	-
S. Newport	-	1	-	-	-	-	-	-	-	-	-
S. Typhimurium	32	-	-	1	2	2	1	-	1	-	15
<i>Salmonella enterica</i> sp diarizonae	-	-	-	-	-	-	-	1	3	-	-
<i>Salmonella enterica</i> sp enterica (I)=4,5:-:1,5	-	-	-	-	-	-	-	-	-	-	1
<i>Salmonella enterica</i> sp enterica (I)=6,7,14:k:-	-	-	1	-	-	-	-	-	-	-	-
<i>Salmonella</i> , not serotyped	89	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	121	2	1	1	2	18	1	1	4	2	16

# Swine vesicular disease

## BACKGROUND

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

## DISEASE

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

## LEGISLATION

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

## SURVEILLANCE

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

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

At present, SVD active surveillance is performed every third 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 the investigation, sampling of

sick or dead animals and examination of the herd for prevalence of clinical signs and production results.

### Active surveillance

Samples collected for the abattoir sampling part of the surveillance carried out by Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS) were used for the active surveillance. See chapter on PRRS for details on sampling and population. The surveillance was designed with a between-herd design prevalence of 1%, a within-herd design 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) was needed (based on structure of the pig production 2012).

## RESULTS

### Passive surveillance

No clinical suspicions of SVD were investigated during 2014.

### Active surveillance

No active surveillance for SVD was performed during 2014. In the surveillance performed in 2013, 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 substantial structural changes leading to a rapidly declining number of herds and extensive changes in the market and in the habits of farmers. The active surveillance in terms of planning design and number of samples is therefore evaluated yearly and adjusted accordingly if needed. Discussions are ongoing within EU and OIE concerning the status of this disease.

# Scrapie

## BACKGROUND

Scrapie belongs to a group of diseases called Transmissible Spongiform Encephalopathies (TSE) and was first described more than 250 years ago. The current theory about the causative agent is the protein-only hypothesis. This theory assumes that misfolded prions (small proteins) induce the same misfolded and pathological structure in normal proteins of the host resulting in accumulation of prions and cellular damage without involvement of any microorganism. Susceptibility to scrapie is genetically related. All routes of transmission have not been established, however, it is clear that transmission of classical scrapie occurs within a flock at lambing and that pastures can be contaminated for long periods of time. Scrapie is based on epidemiological data not considered a zoonotic disease, but the question was raised again in 2014 after experimental infection studies in transgenic mice.

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

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

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

## DISEASE

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

## LEGISLATION

Surveillance and control is regulated through the Regulation (EC) 999/2001 of the European Parliament and of the Council of 22 May 2001. On the national level, surveillance and control is also regulated by the national scrapie control programme and Sweden has since 2003 had additional guarantees related to trade within the union approved through (Commission Regulation (EC) 546/2006). Moreover, sampling at the national level is regulated by SJVFS 2010:9, saknr K19, last amended through SJVFS 2013:3. Scrapie is a notifiable disease under the Swedish Act of Epizootic diseases (SFS 1999:657, with amendments) and there is a scheme to compensate farmers for losses due to eradication measures.

## SURVEILLANCE

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

### Passive surveillance

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

### Active surveillance

The design of the surveillance programme is in accordance with Regulation (EC) 999/2001 Annex III and the Swedish national control programme. Within the programme, all dead sheep and goats over 18 months of age which are not slaughtered for human consumption should be sampled. The carcasses are sampled at rendering plants and at necropsy. In remote areas where there is no collection of carcasses, the farmers must send the whole head to the National Veterinary Institute for testing. Farms with confirmed cases of atypical scrapie are obligated to have increased surveillance in the herd for two years. In

addition to fallen stock, healthy slaughtered animals above 18 months of age are examined from these flocks.

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

## RESULTS

### Passive surveillance

In 2014, two sheep and one goat were examined due to clinical suspicion of scrapie, all were negative.

### Active surveillance

#### *Sheep*

In 2014 the National Veterinary Institute examined 5,755 sheep from fallen stock for scrapie. Out of these, all samples were negative for classical scrapie and six were positive for atypical scrapie Nor98. In addition, 28 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 2014 the National Veterinary Institute examined 153 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 70,000 sheep have been tested without any positive cases detected. In 2014, Sweden sent an application to the European Commission to obtain status as country with negligible risk for classical scrapie. The dossier contained detailed information about the population, imports (which were limited), education about the disease, the national control programme as well as results of estimates of the probability that Sweden is free from classical scrapie. The application is at the time of writing being scrutinized by the European Commission and EFSA.

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 37 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 and that these transmissions can result in disease indistinguishable from classical scrapie. 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.

## REFERENCES

- Fediaevsky A, Maurella C, Nöremark M, Ingravalle F, Thorgeirsdottir S, Orge L, Poizat R, Hautaniemi M, Liam B, Calavas D, Ru G, Hopp P. BMC Vet Res. 2010 Feb 7;6:9. The prevalence of atypical scrapie in sheep from positive flocks is not higher than in the general sheep population in 11 European countries.
- Fediaevsky A, Tongue SC, Nöremark M, Calavas D, Ru G, Hopp P. BMC Vet Res. 2008 Jun 10;4:19. A descriptive study of the prevalence of atypical and classical scrapie in sheep in 20 European countries.
- Elvander M, Engvall A, Klingeborn B. Acta vet Scand 02/1988. 29(3-4):509-10. Scrapie in sheep in Sweden.

# Tick-borne encephalitis

## BACKGROUND

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

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

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

## DISEASE

### Animals

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

### Humans

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

## LEGISLATION

### Animals

Demonstration of TBE virus in animals is not notifiable.

### Humans

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

## SURVEILLANCE

### Animals

There is no surveillance in animals.

### Humans

The surveillance is passive in humans.

## RESULTS

### Humans

In 2014, 178 cases of TBE were reported, which is a slight decrease compared to 2,013 (209 cases) (Figure 19). More men (62%) than women were identified with TBE. The incidence was highest among people in the age group 40-79 years, but there were cases reported from the age of 2 to 94 years of age. All but one case had acquired their infection in Sweden. The single case infected abroad had acquired the infection in Austria.

The first TBE cases became ill in mid-April and the last in the end of November, but the peak occurred in June to October.

The geographic distribution of the disease was mainly, as in previous years, concentrated in the coastal areas of Stockholm, Södermanland and Uppsala counties, both along the lake of Mälaren and the Baltic Sea. The incidence was highest in the county of Södermanland (7.8 cases per 100,000 inhabitants). However, the infection



also occurs in many other parts of the country from Skåne in the south to southern Gävleborg and Dalarna in the north.

#### DISCUSSION

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

ation in combination with a high population of small host animals such as bank voles, and optimal weather for both virus spread and humans spending time outdoors, could explain the large number of cases reported.

The decrease in number of cases in 2014 compared to the year before, may be partially explained by the hot and dry summer of 2014. Such a weather is unsuitable for the tick species transmitting TBE and force it into summer quiescence.

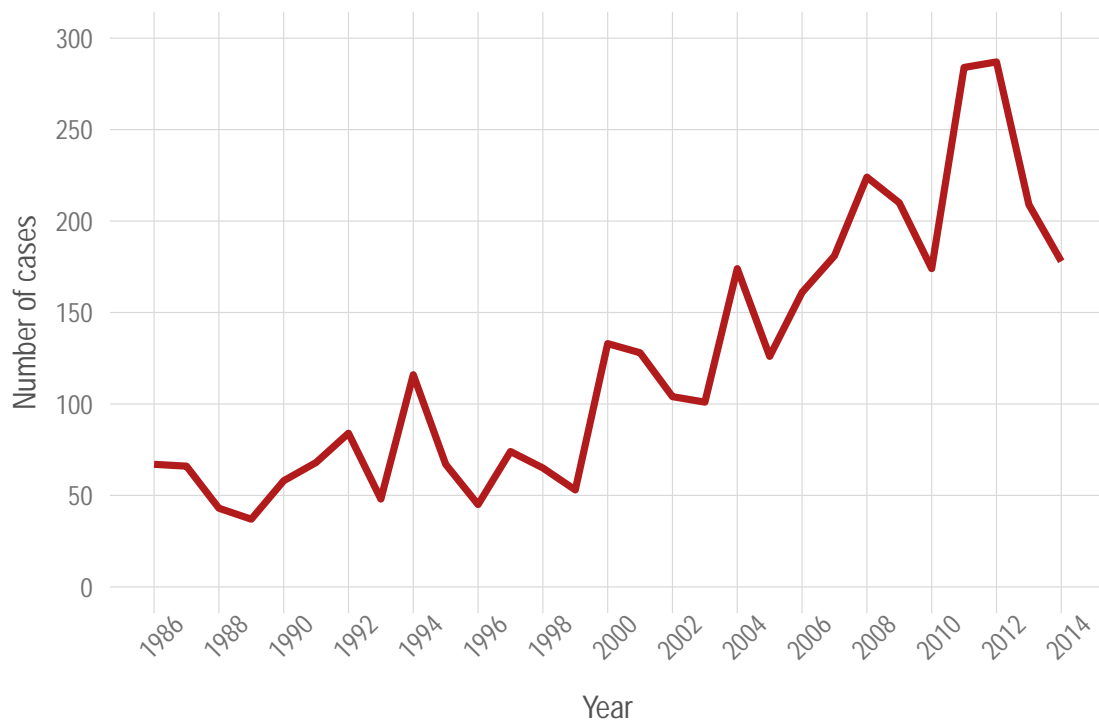


Figure 19: Notified number of cases of TBE in humans 1986–2014.

# Transmissible gastroenteritis



Photo: Bengt Ekberg

## BACKGROUND

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

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

The disease has never been reported in Sweden.

## DISEASE

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

## LEGISLATION

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

## SURVEILLANCE

The purpose of the active surveillance programme is to document freedom from TGE in the Swedish pig population. The National Veterinary Institute is responsible for selection of samples, sample analysis and reporting to the Swedish Board of Agriculture. The serological analyses for TGE antibodies are performed with an ELISA that can distinguish between antibodies to TGEV and PRCV (Svanovir TGEV/PRCV-Ab).

**Passive surveillance**

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

**Active surveillance**

Samples collected for the abattoir sampling part of the surveillance programme carried out by the Farm & Animal Health for porcine reproductive and respiratory syndrome (PRRS) were used for the active surveillance. See chapter on PRRS for details on sampling and population. The surveillance was designed with a between-herd design prevalence of 1%, a within-herd design 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, 420 samples over the year (1 sample per herd from 420 herds) were needed, based on structure of the pig production in 2012.

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

**RESULTS****Passive surveillance**

No clinical cases of TGE were reported during 2014.

**Active surveillance**

There was no active surveillance for TGE during 2014. In the surveillance of TGE during 2013, 216 samples were analysed and in none of them antibodies to TGEV could be found. Three samples were positive for antibodies to PRCV. The number of samples tested for TGEV antibodies in 2013 was considerably lower than planned and taking into account the outcome of the surveillance, the probability of freedom at the end of 2014 was 97%.

**DISCUSSION**

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

# Trichinellosis

## BACKGROUND

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

In Europe, *T. spiralis* and *T. britovi* are the dominant causes of human infections. In Sweden, these species are also detected as well as *T. nativa* and *T. pseudospiralis*. *T. pseudospiralis* is mainly isolated from wild boars. In the gut, *Trichinella* larvae, develop into adults and mate. After mating, the female releases larvae which penetrate the intestinal mucosa and travel via the bloodstream to various organs and muscles. In striated muscles the larvae may survive in an encapsulated form for years.

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

The disease is extremely rare in Sweden and detected human cases are 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 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 wild boars, horses, hunted wild boars and bears are tested for *Trichinella*. The digestion method is the only method applied in testing for *Trichinella*. All domestic pigs that were slaughtered before July 2<sup>nd</sup> 2014 were tested for *Trichinella*. From July and onwards production sites that are officially applying controlled housing conditions were obligated to test all carcasses of breeding sows and boars sent for slaughter each year according to the regulation (EC) No. 2075/2005. Production sites without controlled housing conditions should test all their slaughtered domestic pigs. In conclusion, fattening pigs originating from holdings officially recognized as applying controlled housing conditions were not obligated to test for *Trichinella* in the latter half of the year.

In addition, several species of wild animals are tested for *Trichinella*, including: foxes, lynxes, wolves, badgers, birds and wolverines. The testing was performed by eight laboratories during 2014.

### Humans

Surveillance in humans is passive.

## RESULTS

### Animals

In 2014, all slaughtered horses (3,418) and domestic pigs slaughtered before July 2<sup>nd</sup> (1,277,233) were tested. After July 1<sup>st</sup> 12,531 breeding sows, 347 boars and 534,056 slaughter pigs from controlled housing conditions were tested. In addition, 211,841 slaughtered pigs from uncontrolled housing conditions were

tested. *Trichinella* was not detected in domestic pigs or horses. *Trichinella* spp. was detected from six of 70,274 (0.0085%) wild boar samples and also from 4 lynx, 3 wolverines, 2 wolves, 1 raccoon dog and 1 bear, see Table 17. These figures are based on results from 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 trichinellosis status of this potential case. The person had consumed or handled meat from Swedish wild boar which was not tested for

#### *Trichinella*.

During 2014, one person was infected with *T. spiralis* after consumption of infected pork in Poland. Six persons had eaten a dish prepared from pork. Another two of the six persons who reside in Poland were infected. The meat was analysed in Poland and found positive.

#### DISCUSSION

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

Table 17: Findings of *Trichinella* in wild animals 2014

Animal species	No. samples	No. positives	Percentage (%)	<i>T. britovi</i>	<i>T. nativa</i>	<i>T. pseudospiralis</i>	<i>T. spp.</i>
Arctic fox	1	0	0.00%	–	–	–	–
Badgers	7	0	0.00%	–	–	–	–
Bears	275	1	0.36%	–	1	–	–
Lion	1	0	0.00%	–	–	–	–
Lynx	71	4	5.63%	–	3	–	1
Marten	1	0	0.00%	–	–	–	–
Otter	3	0	0.00%	–	–	–	–
Raccoon dogs	17	1	5.88%	–	1	–	–
Red foxes	53	0	0.00%	–	–	–	–
Seal	1	0	0.00%	–	–	–	–
Wild birds	23	0	0.00%	–	–	–	–
Wild boars <sup>A</sup>	70,274	6	0.0085%	4	1	2	–
Wolverine	25	3	12.00%	–	3	–	1
Wolves	32	2	6.25%	–	2	–	–
<b>Total</b>		17		4	11	2	1

<sup>A</sup> Two species, *T. britovi* and *T. nativa* were detected in one sample.

# Tuberculosis



Photo: SVA

## 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 unpasteurized milk or via inhalation. The predominant cause of human tuberculosis is however *Mycobacterium tuberculosis*. In countries where human tuberculosis caused by *M. tuberculosis* is common, this bacterium is also frequently isolated from various species of animals.

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 7/100,000 inhabitants, which is among the lowest in the world. The vast majority (>90%) of the cases occur in immigrants originating from countries that still have a high incidence of tuberculosis.

## DISEASE

The symptoms caused by tuberculosis in both humans and animals depend largely on the localization 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.

### Humans

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

## Passive surveillance

### Animals

As TB is notifiable on clinical suspicion, clinical signs in animals or lesions detected at necropsy of an animal, prompt official investigations including sampling for bacteriology, tuberculin testing of contact animals and epidemiological investigation, are carried out.

In addition, an investigation is performed if there is reason to suspect exposure of animals to bacteria of the *M. tuberculosis*-complex.

### Humans

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

## Active surveillance

### Animals

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

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

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

## RESULTS

### Animals

The number of animals investigated by histology and, if relevant, bacteriology, due to lesions detected at slaughter were 40 pigs, one calf, one sheep and one horse. From these samples, bacteria from the *Mycobacterium avium/intracellulare*-complex were isolated in 30 pigs. No other samples yielded any mycobacteria. Due to clinical suspicions or lesions found at necropsy, samples from four deer, two cows, one sheep, two elk, one alpaca and four dogs were investigated. From these samples, bacteria from the *Mycobacterium avium/intracellulare*-complex were isolated in two dogs. 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 314. Nine herds were not tested. These herds are exempted from regular testing and instead practice slaughtering of 20% of the herd yearly with meat inspections and necropsies for 15 years to obtain a free status. No TB was detected in any farmed deer in Sweden during 2014.

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 2014, 11 alpacas were tested before export with negative final results.

#### Humans

Four cases of *M. bovis* were reported in humans in 2014, all recent arrivals from Syria, Morocco and Eritrea. None of them had any pulmonary involvement, three had gastrointestinal disease and one had urogenital disease.

## DISCUSSION

#### Animals

The officially free status for bovine tuberculosis has been maintained during 2014. The overall TB situation in animals and humans remains favourable. No cases of TB were detected in Swedish animals during 2014. 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 1940's coincided with the eradication of tuberculosis in cattle and started before the introduction of effective treatment in the 1950's. A much larger part of the human population lived in close contact with domestic animals. This change in contact between humans and animals likely played a role in the changing TB incidence in humans. Today, Sweden has one of the lowest incidences of human tuberculosis in the world.

## REFERENCES

- Alvarez J, Bezos J, Juan Ld, Vordermeier M, Rodriguez S, Fernandez-de-Mera IG, Mateos A, Domínguez L. Diagnosis of tuberculosis in camelids: old problems, current solutions and future challenges. *Transbound Emerg Dis.* 2012 Feb;59(1):1-10. doi: 10.1111/j.1865-1682.2011.01233.x. Epub 2011 Jun 2
- Rhodes S, Holder T, Clifford D, Dexter I, Brewer J, Smith N, Waring L, Crawshaw T, Gillgan S, Lyashchenko K, Lawrence J, Clarke J, de la Rua-Domenech R, Vordermeier M. Evaluation of gamma interferon and antibody tuberculosis tests in alpacas. *Clin Vaccine Immunol.* 2012 Oct;19(10):1677-83. Epub 2012 Aug 22.
- Wahlström, H., Frössling, J., Sternberg Lewerin, S., Ljung, A., Cedersmyg, M. and Cameron, A., 2010. Demonstrating freedom from infection with *Mycobacterium bovis* in Swedish farmed deer using non-survey data sources. *Preventive Veterinary Medicine* 94:108-118.



# Tularaemia

## BACKGROUND

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. *bolarctica* (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, during the last decade tularaemia has also been detected in the European brown hare, and 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 2014, *F. tularensis* was detected from two European brown hares, which is a low number compared to previous years (eleven cases in 2013 and twelve in 2012). The two hares were found dead in Uppsala and Örebro in central Sweden.

### Humans

In 2014, 150 human cases of tularaemia were reported. This was a slight increase in compari-

son to the year before with 114 cases, but seen in a longer perspective the incidence was still relatively low (Figure 20). 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 (63%) than women were reported to be infected in 2014, which is in line with how it has been previous years. The incidence of tularaemia was highest in the age group 40-69 years, similar to previous years. The uneven distribution among age groups and sexes might partially be attributed to their somewhat different leisure and professional activities.

In 2014, 144 of the cases were reported as domestic. As in previous years, except for a few sporadic cases, tularaemia was only reported from the northern, western and central parts of Sweden. During 2014, Värmland and Örebro were the two counties where most people got infected.

Slightly more than a third of the cases were stated to have been infected via an insect bite. The true proportion was likely to be 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 2014, 14 cases were assumed to have been infected through direct contact with animals and two persons by drinking

contaminated water. Six persons had according to the notifications been infected through their work.

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, 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 decreased.

DISCUSSION

Tularaemia has been endemic in northern and central Sweden at least since the early 20<sup>th</sup> 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.

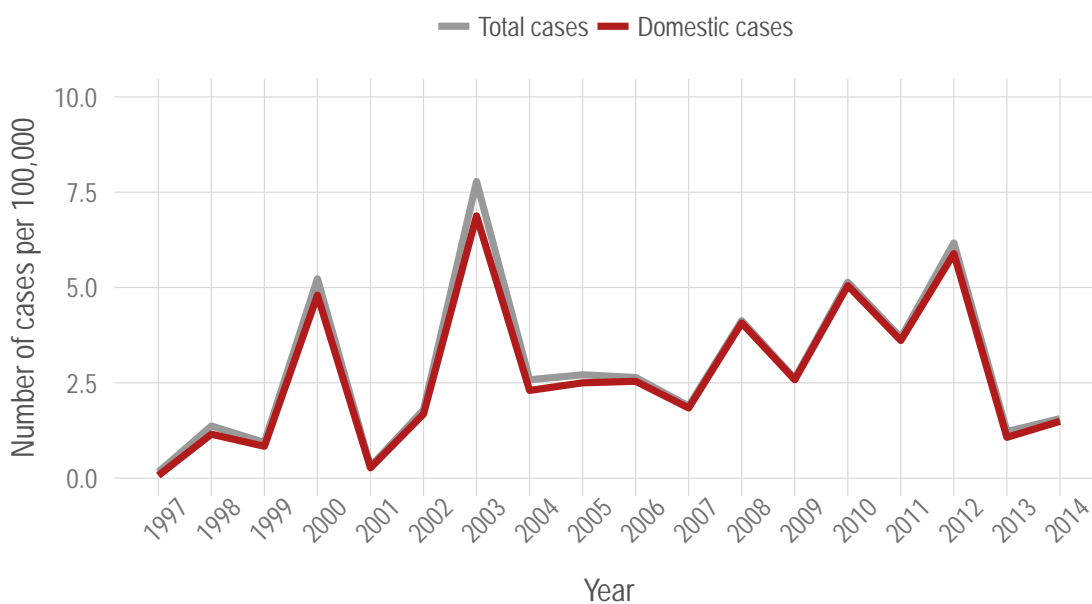


Figure 20: Notified incidence of human cases of tularaemia in Sweden 1997-2014

# Verotoxinogenic *Escherichia coli*

## BACKGROUND

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

VTEC was only sporadically detected in Sweden until 1995 when 114 human cases of EHEC O157:H7 were notified. In 1996, VTEC O157 was isolated in Swedish cattle for the first time and human EHEC O157 infection was traced to a cattle herd. In 2002, an outbreak of EHEC O157:H7 in the county of Skåne affecting 30 persons was caused by consumption of cold smoked fermented sausage. The largest Swedish outbreak so far occurred in the summer of 2005 when 135 reported cases, including 11 (8%) HUS (haemolytic uraemic syndrome) cases were infected with O157:H7 after eating contaminated fresh lettuce irrigated with water from a local stream positive for verocytotoxin 2 at the time of harvest. Indistinguishable isolates from humans and cattle faeces from a farm upstream confirmed the implicated source and control measures, that lead to the termination of the outbreak, were implemented. In 2011, one of the largest known VTEC outbreaks occurred in Germany with 3,816 reported cases of which 845 (22%) developed HUS. Sweden reported the highest number of cases outside Germany (n=53) during this outbreak. The epidemiological characteristics of the cases and the massive media impact and public awareness make this outbreak unique. The need for a continuous prioritisation of EHEC was highlighted by the large outbreak in Germany with serious consequences not only

for the affected individuals but also for politics, the economy, trade and food production in the countries directly or indirectly affected.

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 characterized 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 EHEC infection to animals or to a farm with animals, the County Veterinary Officer will be informed. A request to the Swedish Board of Agriculture will be made for

a trace back investigation and sampling of suspected animals and/or the environment of the animals.

#### Surveys

##### *Animals*

Between 1997 and 2002, annual prevalence studies of VTEC in slaughter cattle were conducted. Since 2002, prevalence studies have been performed every third year. The aim is to detect a prevalence of 0.1% with a 90% confidence level. In each study, 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 for VTEC O157:H7.

##### *Humans*

Surveillance in humans is passive.

## RESULTS

### *Animals*

#### *Active surveillance*

During 2014, ten cattle farms were investigated as suspected sources for human infection. An epidemiological association was established for three farms, one with VTEC O157, one with VTEC O121 and one with VTEC O145.

#### *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 cattle. In the study conducted during 2011-2012, VTEC O157 was detected in 73 of 2,376 faecal samples (3.1%) from cattle. Clade 8 was detected in 15 of the 73 positive samples. In these studies, VTEC O157:H7 has predominantly been isolated from cattle in southern Sweden but rarely from the northern two thirds of the country. The collected samples dur-

ing 2011-2012 were also analysed for VTEC O26 and VTEC O103. VTEC O26 was detected in 8 of 1,308 faecal samples (0.6%) and in 15 of 336 cattle ear samples (4.5%). VTEC O103 was detected in three of 1,000 faecal samples (0.3%) and in three of 500 ear samples (0.6%).

### *Food*

Available results from official sampling by local authorities showed that analysis for VTEC (mostly analysis only for O157) were done as part of the investigation of food poisoning in 6 municipalities and that 23 samples were analysed in that context. No positive results were found.

At the border inspection posts, 19 of 34 samples were positive for a gene associated with virulence (*ea*, *stx1*, *stx2*) or a serotype associated with disease (O157, H7, O145, O111, O103, O26) or both. These 34 samples were taken within the frame of reinforced checks. The findings in the 19 samples were not of a combination that initiated a rejection at the border.

### *Humans*

In 2014, 473 human cases were reported, corresponding to an overall incidence of 4.9 cases per 100,000 inhabitants. Around 60 percent of the cases were domestic (290 cases) which is the second highest number of domestic cases since 2005. The domestic incidence 2014 was 3 cases per 100,000 inhabitants and the increasing trend since 2010 in domestic incidence is continued in 2014. (Figure 21).

As in previous years, most domestic cases (29%) were in the age group of 1-4 years. EHEC has a seasonal variation with the most cases reported during summer months. In 2014, 47% of the domestic cases were reported from July to September.

The domestic incidence was highest in the county of Kalmar (11 cases per 100,000 inhabitants) followed by Halland (10.9), Gävleborg (6.4), Jönköping (6.1) and Västragötaland (4.3). The counties in the southern part of Sweden usually have higher incidences which can partly be due to higher screening frequencies for EHEC of faecal samples from children with diarrhoea.

Of the total number of human cases, 40% were infected abroad and Turkey was the most common country of infection (42 cases) followed by Egypt (15) and Spain (7). Turkey and Egypt are usually the countries outside Sweden where most Swedes become infected with EHEC.

A total of 16 cases of EHEC associated HUS were reported, all but one were domestically ac-

quired infections. One of the HUS cases was over 70 years and all other HUS cases were children under the age of 10.

It was not possible to obtain an isolate from one of the HUS cases. Three of the domestic HUS cases belonged to the serotype O157:H7 (one was double infected with O128), three were O121, two O26, two O111, one O103 (double infected with O145), one O165 and one O59. All of the typable cases were positive for verotoxin 2. One of the isolates with O26 and both of the isolates with O111 were also positive for verotoxin 1. Also, the cases that were double infected were also positive for verotoxin 1. The case that was non-domestic belonged to the serotype O157:H7 and was positive for verotoxin 2.

In 2014, 70% of the domestic EHEC cases were serotyped. Of these, O157 constituted 22% and non-O157 78% of the domestic cases. In the group of non-O157 the serotype O26 were the most common serotype (22%) followed by O103 (12%), O121 (7%) and O145 (5%) and O-Non-Typable (5%).

Most of the reported outbreaks in 2014 were within families and included between 2-6 cases. The serotypes O157:H7, O26, O145, O111 and O121 were represented in these outbreaks.

In May 2014, there was an outbreak in a school, at least 10 children and teachers became ill within several days, but only four cases were screened for verotoxin. Those four cases were positive for both verotoxin 1 and 2. Three of the cases were typed with the serotype O157:H7, with the MLVA-profile 21-7-8-4-6-6-4-10 and with verotoxin subtypes 1a and 2c and positive for the *eae* gene. Unfortunately the local health authority was not able to obtain any samples from the canteen in the school. A buffet of taco with green salad was suspected but never confirmed as a source of infection.

In late August a family of five became ill and positive for EHEC, two of them with verotoxin 1 and three of them with verotoxin 2. It was suspected that their well was contaminated by a nearby farm and it was possible to isolate an EHEC serotype of O5 with verotoxin 1 from the water.

Some outbreaks were associated with farms or recreational activities near farms. In June, two children in the same family were infected with O145, verotoxin 1a. The children were living on a farm with milking cows and therefore the cows were suspected to be the source of infection. However, the testing of the cows was negative for VTEC.

At the end of June, six people in the same extended family were infected with EHEC. Four of the cases were typed with O157:H7, verotoxin 2 and with the MLVA-profile 13-8-10-3-5-6-8-3. The initial cases had, among other things, been swimming and bathing near grassing cattle, but no further testing was done.

In July, four members of the same family were infected with O121. They were also verotoxin 2. They had been living on a farm with cattle for one week before becoming ill. The herd was investigated but found to be negative for VTEC.

In August, a child was infected with EHEC O157:H7 with the MLVA-profile of 15-7-10-4-4-10-5-6 and verotoxin 2 and later developed HUS and was hospitalized. The child had been bathing near grassing cattle and therefore neighbouring farms were tested and found positive.

## DISCUSSION

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.

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

The prevalence among cattle, based on samples taken at slaughter, has since 2005 been in the range of 3.1-3.4%. In these studies, VTEC O157:H7 has predominantly been isolated from cattle in southern Sweden and rarely from the northern two thirds of the country. In the latest survey, positive VTEC O157 samples were also analysed for the subgroup clade 8. There is a tendency for geographical clustering of clade 8.

A joint study between the National Veterinary Institute and the Public Health Agency of

Sweden, was initiated in 2012, with the aim to better understand the epidemiology and the underlying mechanisms of different sources of infection and the importance of different serotypes.

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

REFERENCES

Frank C, Werber D, Cramer JP, Askar M, Faber M, an der Heiden M, Bernard H, Fruth A, Prager R, Spode A, Wadl M, Zoufaly A, Jordan S, Kemper MJ, Follin P, Muller L, King LA, Rosner B, Buchholz U, Stark K, Krause G, HUS Investigation Team. Epidemic Profile of Shiga-Toxin-Producing *Escherichia coli* O104:H4 Outbreak in Germany. *N. Engl J Med* 2011; 365:1771-1780.

Ivarsson S, Jernberg C, Björkholm B, Hedenström I, Lopez G, Regional Investigation Team, Rapid detection and communication of Swedish cases provided early puzzle pieces in the German STEC O104 outbreak, poster Escaide conference 2011.

Sartz L, De Jong B, Hjertqvist M, Plym Forshell L, Alsterlund R, Löfdahl S, Osterman B, Ståhl A, Eriksson E, Hansson H-B, Karpman D. An outbreak of *Escherichia coli* O157:H7 infection in southern Sweden associated with consumption of fermented sausage; aspects of sausage production that increase the risk of contamination, *Epidemiol. Infect.* 2008; 136: 370-380.

Söderström A, Österberg P, Lindqvist A, Jönsson B, Lindberg A, Blide Ulander S, Welinder-Olsson C, Löfdahl S, Kaijser B, De Jong B, Kühlmann-Berenzon S, Boqvist S, Eriksson E, Szanto E, Andersson S, Allestam G, Hedenström I, Ledet Muller L, Andersson Y, A large *Escherichia coli* O157 outbreak in Sweden associated with locally produced lettuce, *Foodborne Pathog. Dis.*, Vol 5, Nr 3 2008.

National guidelines: Infektion med EHEC/VTEC Ett nationellt strategidokument. Available from: <http://www.socialstyrelsen.se/Lists/Artikelkatalog/Attachments/19625/2014-12-17.pdf>

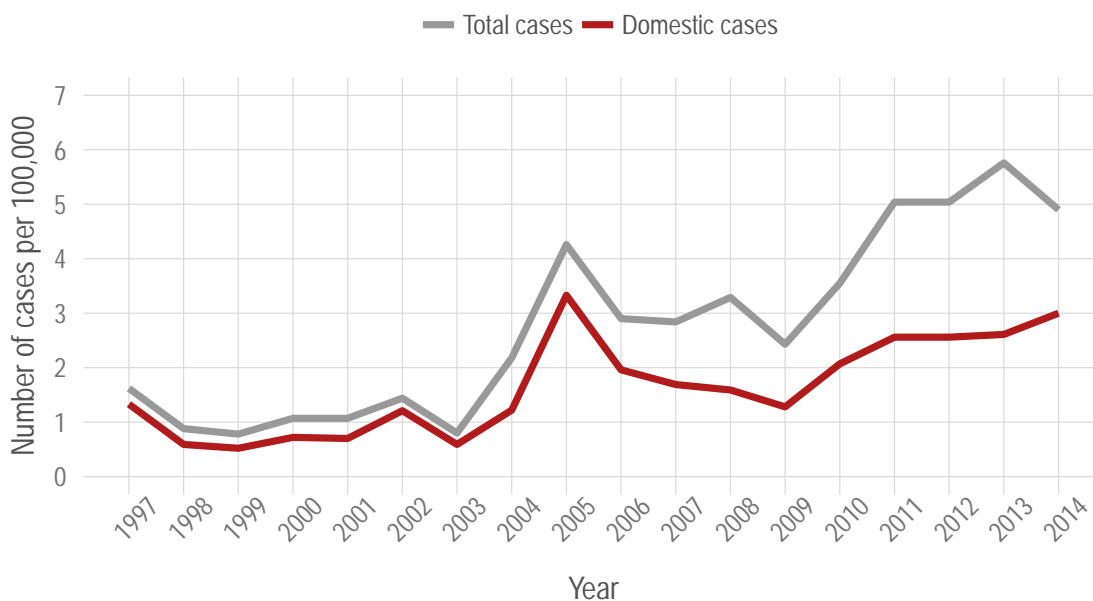


Figure 21: Notified incidence(per 100,000 inhabitants) of human EHEC cases in Sweden, 1997-2014

# 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 nonpathogenic 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*. In Sweden, a study of the presence of *Yersinia* in wild boar captured in 2010–2011 found that 20.5% and 19.3% of 88 tested animals carried *Y. enterocolitica* and *Y. pseudotuberculosis* respectively. Infection with *Y. pseudotuberculosis* in other animals may vary from asymptomatic to severe mesenteric lymphadenitis and lead to septicaemia and death. *Y. enterocolitica* has occasionally been isolated from cats and dogs with diarrhoea.

### Humans

*Y. enterocolitica* causes gastrointestinal symptoms in humans ranging from mild self-limiting diarrhoea to acute mesenteric lymphadenitis, which

might be difficult to differentiate from appendicitis. Longterm sequelae including reactive arthritis, uveitis and glomerulonephritis occur occasionally. Prolonged carriage has been reported in children as well as in adults.

## LEGISLATION

### Animals

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

### Food

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

### Humans

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

## SURVEILLANCE

### Animals

In the fall of 2014 a survey of the presence of *Y. enterocolitica* on Swedish pig farms was completed. Four pen-level faecal samples were collected from each of 105 pig farms with slaughter aged pigs. Isolates of *Y. enterocolitica* were stored and future work will characterize them by biotyping to determine the risk to humans.

### Food

There is no active surveillance in food.

### Humans

The surveillance in humans is passive.

## RESULTS

### Animals

*Y. enterocolitica* was identified from 32 of the 105 sampled farms. In 10 farms either 3 or 4 of the sampled pens were positive for *Y. enterocolitica*, in 22 farms 1 or 2 pens were positive.

### Food

In 2014, a single sample of pig's feet was analysed for presence of pathogenic *Y. enterocolitica*, however, a negative result was obtained.

### Humans

Yersiniosis is mainly a domestic infection. In 2014, 248 cases were reported. Of these, 182

cases (73%) were reported as domestic. Of the 63 cases infected abroad, 14 cases were reported as infected in Spain and four in each of Cuba and Croatia. From other countries only a few cases were reported. During the years 2000–2004, the number of domestic cases of yersiniosis increased until 2004 when 594 domestic cases were reported (Figure 22). Since 2004, the number of cases has decreased. A trend analysis was performed that included all the domestic cases from 2004–2014 and cases from children younger than one year. All age groups showed a statistical significant downward trend with a decrease in incidence of 12–15 % per year. The decrease in incidence for children younger than one year was 7% per year. In 2014, the majority of the domestic cases were in young children and 25% 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 food-borne. 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*.

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, the Public Health Agency of Sweden, the National Board of Health and Welfare and the National Veterinary Institute.

The survey of Swedish pig herds in 2014 showed that the prevalence of *Y. enterocolitica* among Swedish pig farms (30.5 %) is similar to other pig producing regions where *Y. enterocolitica* has been studied. The importance of the presence of this bacteria in Swedish pigs on human health cannot be fully understood without further characterization of the identified isolates.

#### REFERENCES

Sannö A, Aspán A, Hestvik G, Jacobson M. Presence of *Salmonella* spp., *Yersinia enterocolitica*, *Yersinia pseudotuberculosis* and *Escherichia coli* O157:H7 in wild boars. *Epidemiol Infect.* 2014; 142(12):2542–2547.

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

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

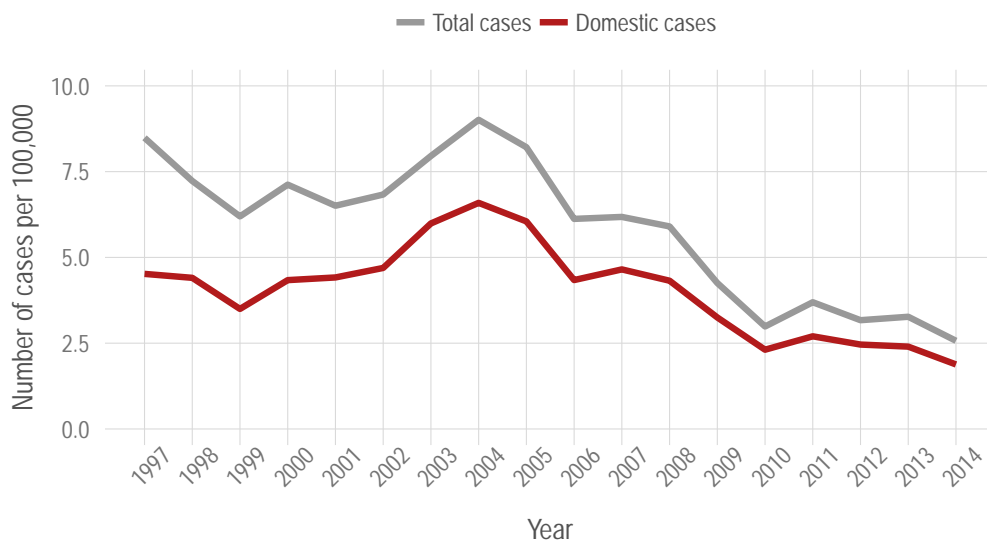


Figure 22: Notified incidence (per 100,000 inhabitants) of human cases of yersiniosis in Sweden, 1997–2013



# **Additional Surveillance 2014**

# Clinical passive surveillance

## BACKGROUND

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

### African swine fever

African swine fever (ASF) is a contagious disease of domestic and wild pigs, in its acute form characterized 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 2014 ASF was reported in wild boar as well as domestic pigs from Estonia, Latvia, Lithuania and Poland. The risk for further spread within EU is considered high. Because of the typically acute clinical course with high mortality rates associated with the strains of ASF virus currently circulating in Eastern Europe, early detection is most efficiently achieved through clinical passive surveillance.

### Anthrax

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

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

### Foot-and-mouth disease

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

## LEGISLATION

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

## SURVEILLANCE

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

system is considered a component of targeted surveillance aimed at increasing the number of samples submitted for analysis of notifiable diseases. The Swedish Board of Agriculture covers all costs for veterinary visits, transports, and diagnostic analyses related to the investigation.

#### African swine fever

Reported cases of increased mortality or serious morbidity, with clinical signs such as haemorrhagic disorders or reproductive failures, in pigs 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 2014, 111 suspicions of epizootic diseases were reported and further investigated based on sampling of sick or dead animals (Table 18).

One clinical suspicion of ASF in breeding sows, which presented with acute disease with fever, discoloration of the ears and mortality, was investigated. Samples were collected and sent to the National Veterinary Institute for PCR detection with negative result. Samples were also analysed for CSF and PRRS with negative results.

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

One clinical suspicion of FMD in cattle with vesicular lesions in, or around, the mouth, udder and feet, was investigated. The cow presented with very acute clinical signs, but none of the other 80 dairy cattle within the herd showed any clinical signs. Although the case was considered a low-grade suspicion, FMD could not be excluded based on clinical investigation. Samples were sent to the National Veterinary Institute for PCR and serology. All samples were negative and FMD could be excluded.

Newcastle disease was confirmed in three commercial layer flocks in Östergötland County in June-July 2014. The flocks presented with egg drop and egg abnormality and were detected within the clinical passive surveillance. Affected flocks were culled and restriction zones established in accordance with EU legislation. The last restriction zones were lifted on August 6<sup>th</sup> 2014.

## ADDITIONAL SURVEILLANCE 2014

Table 18: Number of suspicions of epizootic diseases reported through the clinical passive surveillance system during 2014 and investigated by experts at the National Veterinary Institute after notification to the Swedish Board of Agriculture.

Disease	Investigated	Confirmed
African swine fever	1	0
Anthrax	18	0
Aujeszky's disease	2	0
Avian influenza	16 <sup>A</sup>	0
Bluetongue	2	0
Brucellosis	2	0
BSE	3	0
Classical swine fever	5	0
FMD	1	0
IBR/IPV	1	0
Newcastle disease	25 <sup>B</sup>	3
Paratuberculosis	7	0
PRRS	4	0
Rabies	5	0
Scrapie (classical and atypical)	3	0
Tuberculosis	14	0
Vesicular stomatitis	0	0
West Nile fever	1	0

<sup>A</sup> Does not include wild birds found dead

<sup>B</sup> Includes 16 suspicions in poultry also investigated for AI and described under the specific chapter on AI. In addition, a number of cases related to the ND outbreak were only 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 2014 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 fetuses 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, twelve outbreaks of Newcastle Disease have occurred in Sweden. The disease is included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments). Since all outbreaks have been successfully eradicated, Sweden has a status of Newcastle free country without vaccination according to Commission Decision 95/98/EEC.
- Egg drop syndrome - the virus is a naturally occurring adenovirus in 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 2014, seven different breeding companies participated in the programme; four broiler-, two laying hen-

## ADDITIONAL SURVEILLANCE 2014

and one turkey breeding company. In accordance with the provisions of the programme, sixty blood samples were taken from the breeding flocks included in the programme, once during the rearing period and several times during the production period. The blood samples were sent by mail to the National Veterinary Institute where serological tests were performed. The sampling and testing schemes are presented in tables 19 and 20.

### RESULTS

Table 21 gives an overview of all samples taken in breeding flocks of chickens and turkeys, and the laboratory methods used, during 2014. All analysed samples tested negative for *Salmonella* Gallinarum, *Salmonella* Pullorum, *Mycoplasma gallisepticum*, *Mycoplasma meleagridis* and paramyxovirus type 1.

During 2014, 17 chicken flocks (two grand-

parent and 15 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.

In conclusion, the results from the serological screening in the Poultry Health Control Programme in 2014 support the status of freedom from the infections included in the Swedish breeding poultry population. However, the clinical surveillance of the poultry breeding population is also of utmost importance.

Table 19: Sampling schedule for chicken grandparent and parent flocks. Number of blood samples tested at different weeks of age.

Agent	Age in weeks				
	16	24	36	48	60
<i>S. Pullorum/ S. Gallinarum</i>	-	60	-	-	-
<i>Mycoplasma gallisepticum</i>	60	60	60	60	60
Paramyxovirus type 1	-	-	-	60	-
Egg drop syndrome-virus	-	30	-	-	-

Table 20: Sampling schedule for turkey parent flocks. Number of blood samples tested at different weeks of age.

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

Table 21: Number of sampling occasions for grandparent (GP) and parent (P) flocks of chickens and turkeys and total number of samples tested during 2014.

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>	10	62	4	600	3,720	240	Serum plate agglutination test
<i>Mycoplasma gallisepticum</i>	49	337	16	2,940	20,220	960	ELISA MG antibody test, ID.Vet
<i>Mycoplasma meleagridis</i>	0	0	16	0	0	960	Serum plate agglutination test
Paramyxovirus type 1	9	73	4	540	4,380	240	NDV screen competition ELISA, ID.Vet
Egg drop Syndrome-virus	10	62	0	300	1,860	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) from Russia and other countries in Eastern Europe into the EU involves wild boar and the direct and indirect contacts between domestic pigs and wild boar in these areas hamper the control and management of the disease. The Swedish wild boar population is increasing rapidly and is presently estimated at 200,000 animals before the reproductive season of 2015. The northern border of the wild boar habitat is extending north and has at present passed the level of the river Dalälven. Since the year 2000, hunted wild boars from different parts of the country have been blood sampled yearly for surveillance purposes. The samples have been sent to National Veterinary Institute for analysis for antibodies to infectious agents that are of importance for the domestic pig production. Due to the worrying situation regarding ASF in Eastern Europe and within EU a passive surveillance for the disease in wild boars found dead was added to the surveillance programme during 2013 and is ongoing.

## LEGISLATION

The infections investigated in the wild boar surveillance programme of 2014 are all included in the Swedish Act of Epizootic diseases (SFS 1999:657 with amendments) and are notifiable on suspicion. If any of them are suspected or confirmed, measures will be taken to control the disease and to prevent further spread.

## SURVEILLANCE

### Passive surveillance

Organ samples from, or whole carcasses of wild boar found dead were brought in for post mortem examination at the National Veterinary Institute. All submitted wild boars or samples thereof were subjected to African swine fever virus 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, classical swine fever virus and *Brucella suis*. 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

Five wild boars found dead were examined for African swine fever virus and all analyses were negative. They were found in south and south-east Sweden (Figure 23). Additional post mortem findings in these wild boars are reported under the heading 'Post mortem examinations in wildlife' in this report.

### Active surveillance

In 2014, 403 samples were collected from shot wild boars. The geographical distribution of sampled wild boars was roughly correlated to the distribution and density of the Swedish wild boar population (Figure 23). All analyses for Aujeszky's disease and classical swine fever were negative. One sample was positive for antibodies to porcine reproductive and respiratory syndrome virus after confirmation and rendered further investigation of wild boars in the close proximity and of possible contacts with domestic pigs in the area. The investigation led to the conclusion that the sample was a 'singleton reactor' and not caused by true infection with porcine reproductive and respiratory syndrome virus. Antibodies to *Brucella suis* were not found in 339 of the samples and in 64 samples the results were inconclusive due to hemolysis. The well-known problem with quality of wildboar blood samples is thus particularly influencing the agglutination method used for *Brucella suis* in this surveillance.

The sensitivity of the active surveillance was lowered to about 98% for porcine reproductive



and respiratory syndrome, Aujeszky's disease and classical swine fever and to about 97% for *Brucella suis* 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 2014 are or have recently been present in neighbouring countries or in close proximity to Sweden. The unfavourable development of the African swine fever situation in Russia, Eastern Europe and within EU is of special concern and calls for reliable methods for early detection of disease in the wild boar population.

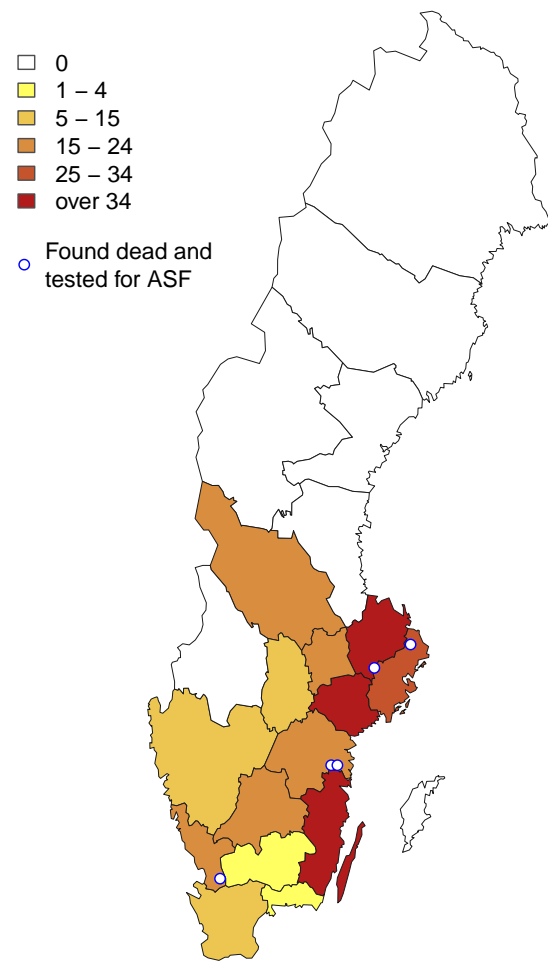


Figure 23: Geographical distribution of the number of hunted wild boar per county sampled in 2014. The white points indicate locations of 5 wild boar that were found dead and then tested negative for African swine fever (ASF). ©EuroGeographics for the administrative boundaries.

# 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 surveillance for the diseases mentioned below since the late 1980's in accordance with EU Directives 2001/183 and 2006/88. Sweden has an approved disease free zone status (2002/308/EC) for Viral haemorrhagic septicaemia (VHS) and Infectious haematopoietic necrosis (IHN) (2008/427/EG). Additional guarantees are in place for the whole country for Spring Viraemia of Carp (SVC) and for the continental zone for Infectious Pancreatic Disease (IPN) (2010/221/EC). The continental zone of Sweden has an eradication programme for Renibacteriosis/bacterial kidney disease (BKD) and the coastal zone for IPN (2010/221/EU). These diseases are included in the Swedish legislation of notifiable diseases (SJVFS 2013:23). Further, IHN, VHS, IPN (other than serotype ab) and SVC are included in the Swedish Act of epizootic diseases (SFS 1999:657 with amendments). In addition, samplings and diagnostics are routinely done for Koi herpes virus (KHV) in imported, quarantined koi, Crayfish plague

in Crayfish and Bonamiosis 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 rhabdoviruses and occur frequently in Europe. They are transferred horizontally, but vertical transmission cannot be completely ruled out for IHN. Both diseases have greatest impact in aquaculture of rainbow trout (*Oncorhynchus mykiss*) in freshwater, but have also been detected in several other species. Infected fish exhibit behavioural changes, lethargy and abnormal swimming (whirling). The fish are anaemic with varying degrees of bleeding in multiple organs. VHS is found in a marine form, and a low frequency in wild populations of sensitive species cannot be excluded in the Swedish coastal zone.

Infectious pancreatic necrosis (IPN)

IPN is caused by a Birnavirus that is highly infectious to juvenile salmonids. Susceptibility declines with increasing age. Fish that survive infection become subclinical carriers. In addition to salmonids, virus has been detected in several other species. The virus is transmitted both horizontally and vertically.

The disease has large consequences, with high mortality in young fish, and is considered as one of the most costly in several European countries. Symptoms include darkening, abdominal distension and corkscrew swimming. Bleedings in abdominal fat and internal organs are the most dominant internal findings. Mortality rates can vary between 10-90%.

Renibacteriosis (BKD)

BKD is caused by a gram positive bacterium, *Renibacterium salmoninarum*. The infection can be transmitted both horizontally and vertically. The disease favours low water temperatures, and outbreaks occur mainly at temperatures between

7-15 degrees.

Salmon and arctic char are most susceptible to BKD and mortality can reach 80%. In rainbow trout, the disease is chronic with a continuous low mortality of about 5-10%, however outbreaks of up to 40% mortality can occur. Infected fish may have reduced growth and disease can result in a deterioration of quality of the meat.

#### Spring viraemia of carp (SVC)

SVC is caused by a rhabdovirus. The disease occurs in Asia and several European countries. The virus has been detected in several fish species in the cyprinid family. The virus is transmitted horizontally. The clinical signs are usually general, such as darkening, exophthalmia and a slow breathing. The fish swim lazily with sporadic periods of hyperactivity. Other common findings are pale gills, ascites and haemorrhages in the skin and gills. Internally, bleedings are found in various organs including muscle, swim bladder and the brain.

#### Koi Herpes virus (KHV)

KHV is caused by a DNA virus and affects common carp (*Cyprinus carpio*) and variants thereof, including koi. The virus was first detected in 1998 and has since then been reported from all continents except Australia. The virus is transmitted horizontally. KHV can cause severe problems and is associated with high mortalities. Infected fish usually swim at the surface and have an increased breathing frequency. Symptoms include enophthalmia, spotted gills and secondary bacterial or parasitic infections on gills and skin. Surviving carps can become subclinical carriers.

#### Crayfish plague

Crayfish plague is caused by an aquatic fungus (*Aphanomyces astaci*), which spread to Europe in the late 1800's from the U.S. with live crayfish. The disease occurs throughout Europe and North America. The fungus reproduces by spores spread in the water. When the spores infect crayfish they grow through the skin and attack the underlying tissues.

The signal crayfish becomes subclinically infected but may exhibit black (melaninated) areas in the shell adjacent to the presence of the fungus in the skin. The spots will disappear when the shell is shed, but may gradually reappear.

When noble crayfish is infected the first sign is high mortality in affected populations. Disease in the individual is characterized by behaviour changes such as moving during daytime, reduced

coordination and balance difficulties.

#### White spot disease (WSD)

WSD is caused by a Whispovirus (WSSv) that can infect a wide range of aquatic crustaceans including marine, brackish and freshwater prawns, crabs, crayfish and lobsters. Outbreaks occur at water temperatures of 18-30°C. The most common clinical sign is white spots in the exoskeleton, but the disease can occur without obvious external signs.

The virus is transmitted both horizontally and vertically and has a long survival time outside the host animal. The virus is present in imported frozen raw giant shrimps. There is a non-negligible risk that the virus will be introduced to the aquatic environment by anglers using these shrimps for bait. The consequences are difficult to predict but may have a negative impact on Swedish crustacean populations.

#### Marteiliosis

Marteiliosis, a disease in oysters and blue mussels, is caused by a unicellular parasite (*Marteilia refringens*). The parasite needs a crustacean (*Paracartia grani*) as an intermediate host. The disease causes reduced fitness, impaired growth and resorption of the gonads and hence reduced reproductive capacity. When the animals weaken, they cannot keep the shell halves closed. The parasite is considered to exist in two forms; the 'o' form, which occurs in oysters, and the 'm' form, which occurs in blue mussels.

#### Bonamiosis

Bonamiosis is a disease in oysters caused by the protistan parasite *Bonamia ostreae*. The parasite invades and destroys the haemocytes. Usually the only sign of disease is increased mortality in the infected oyster population. *B. ostreae* is found along the European Atlantic coast as far up as Denmark, where it has now been found in Limfjorden.

#### SURVEILLANCE

Within the Official Control Programme, there is active surveillance for the viruses IHN, VHS, IPN and SVC, and also for renibacteriosis/BKD. All farms are tested for presence of the aforementioned diseases. The aim is to document freedom from disease and to contribute to the maintenance of this state. Sampling frequency is based on classification of each farm into one of three categories (high, medium or low risk) after a risk analysis based on the risk for the farm becoming

infected; the risk that the farm will further spread the pathogen and the impact of the pathogen.

There is also active surveillance in imported quarantined fish (eel - IPN and koi/carp - KHV) and both farmed and wild shellfish are sampled for Marteilirosis and Bonamiosis since 2011. Active surveillance is also done when potential invasive alien species - like the marble crayfish - are discovered.

For fish, there is also a voluntary health programme, where samplings are performed at disease outbreaks, thus passive surveillance. The combination of the Official Control Programme and the voluntary health programme provides a good foundation for early detection of new, exotic diseases, thereby improving the possibility to control emerging diseases.

Crayfish plague is monitored by passive surveillance - analysis is done based on suspicion of disease outbreaks.

#### DIAGNOSTICS

All diagnostic analyses are performed according to recommendation by EU or OIE at the Swedish reference laboratory, the National Veterinary Institute. VHS, IHN, IPN and SVC are tested on pooled organ material (spleen, kidney, heart/brain) by a cell culturing method. A pool consists of organs from up to ten fish. A cell culture is defined as virus positive if a cytopathogenic effect is detected within two weeks, after which the virus is identified by serum neutralisation (SN-test), ELISA or in some cases PCR. KHV is tested on individual fish by PCR. Thirty fish are sampled in regular fish farms, and in compensatory breeding farms up to 60 fish are sampled after stripping of roe. In the case of carp/koi, only a few fish may be sampled and in eel quarantine as many as 120 fish are sampled.

BKD is tested on kidney tissue from individual fish and demonstrated by an ELISA method and verification is done by PCR. Thirty fish are sampled in regular farms and in compensatory breeding farms up to 60 fish are sampled after stripping of roe.

*A. astaci* is demonstrated by light microscopy and cultivation and verified by realtime PCR, and WSSv is detected by rt-PCR. The number of sampled animals varies from case to case.

*B. ostreae* and *M. refringens* is demonstrated by PCR in individual animals, 30 from each production site. Confirmation is done by histology.

#### RESULTS

Official health programme for fish farmers, crustacean and mollusc surveillance

The number of samples analysed and results are shown in table 22. In summary, the active surveillance detected (one case=one outbreak):

- 1 case of IPNab in rainbow trout, coastal zone
- 6 cases of BKD (2 farms, 2+4 production sites), inland zone, in rainbow trout and arctic char
- 6 cases of Crayfish plague
- 4 cases of Marteilirosis, one in farmed blue mussels, three in wild blue mussel populations, all on the west coast.

Voluntary health programme for fish farmers

There was one recorded outbreak of other notifiable diseases in fish during 2014; Yersiniosis (ERM) on an inland farm. In addition, there were two single cases of ERM in wild fish, one in salmon in fresh water but in the coastal zone, and one in cod in the Baltic Sea.

*Outbreaks in wild fish, crustaceans and molluscs*

There were two outbreaks causing mortality in wild populations. The first was a new rhabdovirus causing mortality in eelpout (*Zoarces viviparus*) along the south-east coast during the summer, the other was an outbreak of Ostreid Herpesvirus-1 Var in giant oysters (*Crassostrea gigas*) on the west coast in the late autumn.

#### DISCUSSION

The number of farms that were sampled for the viruses listed in table 22. Swedish aquaculture has a good health status, where all severe diseases of importance are absent. The most problematic disease to control is renibacteriosis/BKD, due to its vertical transmission and variable clinical presentation. Control of BKD is expected to be improved by modified sampling and improved methodology, from today's post mortem sampling to an in vivo method. The number of farms with BKD was in line with expectations, but the number of infected production sites within these farms is troublesome. This indicates that farmer awareness of biosecurity has started to deteriorate. Additional resources must be invested in risk based analysis of individual aquaculture farms to get a more reliable assessment for health surveillance. Marteilirosis

has previously been identified in Sweden. This year's sampling identified positive mussels at a new sampling site within the containment zone, but also in two new areas. The crustacean intermediate host of *Marteilia refringens* is not supposed to be present in Swedish waters, it is typically an inhabitant of warmer waters. Because of this, it is not clear how the disease was introduced to Sweden. Some possibilities include: streams, ballast water or illegal import of alien mollusc species. Import of alien species (illegal or legal) always poses a risk for introduction of exotic pathogens. For example, the pacific oyster (*Crassostrea gigas*) can carry *Bonamia ostrea* without showing any clinical signs. *C. gigas* is considered an invasive alien species but is present at the west coast, and there is interest in farming this

species. In the autumn 2014 there was a sudden mass mortality (<100%) outbreak in *C. gigas* spat in the one farm with permission to produce spat. Later, mortalities were also found in wild population of adult *C. gigas*. Ostreid herpesvirus-1 Var was identified in the spat as well as in two sampled sites with adult oysters. 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 22: Samples taken in the Swedish surveillance programmes for notifiable diseases in fish, crustaceans and molluscs

Disease	No. of sampled production sites	No. of infected production sites	No. of tested individuals	No. of tested pools	No. of infected individuals/pools
<b>Fish</b>					
VHS	83	-	-	452	-/0
IHN	83	-	-	452	-/0
IPN	83	1	-	452	-/1 <sup>E</sup>
SVC	2	-	-	10	-/0
KHV	2	0	14	41	0/0
BKD	85	6 <sup>C</sup>	2,633	-	6 <sup>F</sup> /-
<b>Crustaceans</b>					
<i>Aphanomyces astaci</i>	10	4	-	21	9/5
WSSv	1	-	-	1	0/-
<b>Molluscs</b>					
<i>Bonamia ostreae</i>	5 <sup>A</sup>	0	150	-	0/-
<i>Marteilia refringens</i>	10 <sup>B</sup>	4 <sup>D</sup>	390	-	22/-

<sup>A</sup> 1 wild oysters

<sup>B</sup> 5 blue mussel farms, 5 wild populations

<sup>C</sup> 2 farms with 2 and 4 infected production sites respectively (farm one: both production sites in the same river, farm two: 2 production sites in one river, 2 production sites in a lake + the river originating from the lake)

<sup>D</sup> 1 mussel farm, 3 wild populations

<sup>E</sup> By ELISA, PCR verified infection in 3 of 6 fish, in addition, source tracking in the two infected farms identified another 60 positive and 7 suspects (borderline positive) by ELISA. These were not confirmed by PCR since they were samples from the same farms that were already identified as positive

# 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 parts of 2012 and 2013, Schmallenberg virus (SBV) was analysed as well. These infections often cause abortion, therefore sampling

of aborted foetuses means sampling within a risk group and increases the chance of detecting the infectious agent if present in the country. The Swedish Board of Agriculture finances sampling and testing of foetuses for *Brucella*, PRRS and CSF. All diagnostic testing was performed at the National Veterinary Institute. The foetuses were analysed for the CSFV and PRRS genome with PCR and *Brucella* by bacterial culture.

## RESULTS

Since the start in 2008, various numbers of foetuses of different species have been examined each year (Table 23). The numbers for 2012 and 2013 were extraordinary high, most likely because of increased attention due to the newly identified infection with Schmallenberg virus (SBV).

## 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 in 2012 and 2013. Testing for SBV ended in 2013 because the disease, at that time, had become established in Sweden and therefore was considered endemic.

Table 23: Number of examined foetuses in the surveillance since start 2008

Species	2008	2009	2010	2011	2012	2013	2014
Cattle	14	15	62	21	63	114	32
Goat	0	0	9	3	5	4	2
Sheep	0	29	70	45	79	89	28
Alpaca	0	2	5	0	0	4	0
Bison	0	0	0	0	1	1	0
Gnu	0	0	0	0	0	1	0
Visent	1	1	0	2	1	0	0
Pig	37	79	61	51	54	46	31
<b>Total</b>	<b>52</b>	<b>126</b>	<b>207</b>	<b>122</b>	<b>203</b>	<b>259</b>	<b>93</b>

# Post mortem examinations in food producing animals

## BACKGROUND

Early detection of infectious diseases is of utmost importance in order to prevent negative effects. For diseases with severe clinical signs the first line of defence is the detection of disease by animal owners, field veterinarians and pathologists. International and national experience, show that post mortem examinations remain a vital part in disease control and detection of emerging diseases.

As post mortem examinations are considered an important part in the early detection and national disease surveillance, a specific programme for encouraging such examinations by financial means started in the early nineties. The Swedish Board of Agriculture finances the programme, with support of fees from the animal owners. Farm and Animal Health is responsible for the organisation.

## 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 routinely collected from defined categories of animals for surveillance of salmonellosis (the first half of 2014), paratuberculosis, PRRS, CSF, brucellosis, TSE and antimicrobial resistance.

The programme also includes further education of veterinarians and the veterinary employees at the post mortem facilities. Yearly courses are held and quarterly newsletters are produced.

Transportation of the carcasses to the laboratories is arranged and financed by the owner. This can be a problem for large animals, particularly when the distance between the farm and post mortem facility is long.

## RESULTS

During 2014 post mortem examinations were performed at five different sites, all of which were located in the southern half of Sweden: Skara (Eurofins Food & Agro), Kristianstad (Eurofins Food & Agro), Uppsala (the National Veterinary Institute and the University of Agriculture), Visby (Farm and Animal Health Service) and Karlskoga (Farm and Animal Health). Large animals, such as adult cattle, were examined at four of these sites, Uppsala, Kristianstad, Karlskoga and Visby. A total of 2,868 post mortem examinations were performed within the programme during 2014.

The distribution of species examined over the last 10 years are shown in table 24. The change in the number of animals within the largest livestock producing sectors (swine, cattle, sheep and poultry) is illustrated in figure 24.

In 2014, 80 cases were diagnosed as a notifiable disease at post-mortem examination. Table 25 shows the reported primary cases of notifiable diseases.

Table 24: Distribution of food producing species submitted to postmortem examination, 2005-2014.

Year	Pigs	Cattle	Sheep	Goat	Farmed deer	Poultry	Exotic ungulates	Total
2005	2,190	839	550	13	26	49	1	<b>3,668</b>
2006	2,543	733	630	7	38	39	–	<b>3,990</b>
2007	1,434	660	545	17	39	80	7	<b>2,782</b>
2008	1,173	646	613	15	43	480	10	<b>2,981</b>
2009	1,112	655	510	11	10	656	18	<b>2,977</b>
2010	932	773	637	24	13	391	25	<b>2,797</b>
2011	737	707	611	23	11	460	28	<b>2,578</b>
2012	862	826	749	35	11	630	37	<b>3,151</b>
2013	667	983	840	34	18	749	43	<b>3,336</b>
2014	502	747	548	14	11	1,006	40	<b>2,868</b>

DISCUSSION

The post-mortem examinations are a vital part of the national surveillance for infectious and emerging diseases, as illustrated by the detection of 80 index cases of notifiable disease in 2014. 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, with a steady decline in swine and an increase in poultry.

A regional imbalance can be seen in that more examinations are performed in the relatively few regions with local post mortem examination facilities. The highest numbers of examinations are performed in regions with high animal density and access to a regional laboratory performing post mortem examinations.

Distance and 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, was initiated during 2014 and will continue in 2015.

REFERENCES

Wahlström, H. 2003. Sjukdomsövervakning hos animalieproducerande djur - en översyn på uppdrag av Jordbruksverket och Köttböndernas Forskningsprogram.

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

Personal communication, Jenny Lundström Swedish Farm and Animal Health Service.

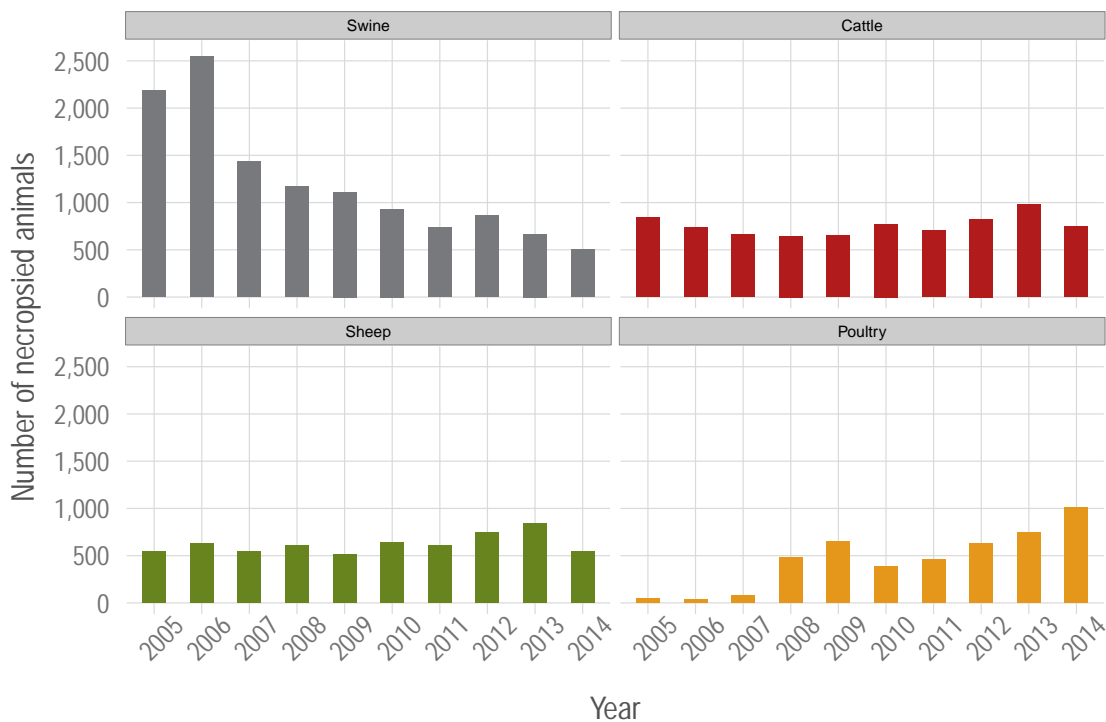


Figure 24: Number of necropsies by selected animal species over a 10 year period



Table 25: Number of index cases of a notifiable disease 2011-2014, diagnosed from samples taken at post mortem examination.

Disease	2011	2012	2013	2014
Anthrax	1	0	0	0
Avian rhinotracheitis	–	–	1	0
Avian tuberculosis (poultry) <sup>A</sup>	2	1	–	–
Blackleg	7	8	7	4
Duck Viral Enteritis <sup>B</sup>	7	8	7	4
Bovine Malignant Catarrhal fever	0	1	3	1
Fowl Cholera (pasteurellosis)	2	0	0	0
Fowl typhoid ( <i>S. Gallinarum</i> )	0	1	0	0
Infectious Bronchitis	2	4	0	0
Infectious laryngotracheitis	16	17	36	35
Influenza, pigs	0	3	1	1
Influenza A typ (H1N1) 2009	–	–	3	0
Listeriosis	35	38	49	31
Lymphoma ( <b>not EBL</b> )	7	11	–	–
<i>Mycoplasma gallisepticum</i>	0	3	0	4
<i>Mycoplasma</i> , poultry ( <b>not gallisepticum</b> )	2	3	–	–
Necrotic haemorrhagic enteritis ( <i>Clostridium perfringens</i> type C)	0	1	0	–
Salmonellosis	4	3	2	3
<b>Total</b>	<b>78</b>	<b>94</b>	<b>102</b>	<b>80</b>

Statistics from Farm & Animal Health.

<sup>A</sup> this disease is no longer notifiable since November 2012, thus one case previously reported was removed from 2012.

<sup>B</sup> This disease was not previously diagnosed in Sweden.



Photo: Erik Ågren

# Post mortem examinations in wildlife

## 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 receives 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 specific 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 especially hunters, submit wildlife that is found dead, or found sick and then euthanized, to the National Veterinary Institute for examination. The aim of the general and targeted wildlife disease surveillance programmes is to monitor the health status of wildlife in Sweden, as well as presence or absence of diseases. 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 2014, almost 1,000 wild animals were submitted and examined at the Department of Pathology and Wildlife Diseases. This includes fallen wildlife, parts of fallen wildlife and lesions found in game animals. In addition, standard samples collected from hunted large carnivores or other hunted game species were received within re-

search projects and bio-bank sampling. 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 necropsied at the pathology department. Samples from these species may also be submitted when hunted or euthanized as nuisance animals. Licensed hunting of lynx and brown bear was done in 2014. There were 342 birds or samples from birds examined, including 82 eagles, which are systematically sent to the Institute together with other listed protected species.

In 2014, 153 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 passerine birds and hedgehogs, myxomatosis in wild rabbits, and *Trichomonas* infections in passerine birds. An outbreak of avian influenza with a new virus H10N7 was also noted among harbour seals (Table 26)

The surveillance of the fox dwarf tapeworm *Echinococcus multilocularis* was ended in 2014, after a three-year long nation-wide screening of scats from foxes. The result was findings of infected foxes in five small foci within four counties, giving a total of six known infected areas in Sweden since 2011. A network of hunters collected and submitted the majority of the scats for PCR analysis. A more focused local screening of hunted foxes around these known sites of *Echinococcus* infection in Sweden is ongoing, 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, although new diseases or parasites in wildlife are discovered most years. 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

## ADDITIONAL SURVEILLANCE 2014

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 26: OIE non-listed wildlife diseases and number of outbreaks/cases reported to the OIE for 2014.

Disease	Species	Latin name	Number of cases
Avian influenza H10N7	Harbour seal	<i>Phoca vitulina</i>	9
Avian tuberculosis	Common eider	<i>Somateria mollissima</i>	1
Avian tuberculosis	White-tailed sea eagle	<i>Haliaeetus albicilla</i>	1
Echinococcus multilocularis	Red fox	<i>Vulpes vulpes</i>	3
Elaphostrongylus	Moose	<i>Alces alces</i>	7
<i>Francisella tularensis</i>	European brown hare	<i>Lepus europaeus</i>	2
Listeriosis	Roe deer	<i>Capreolus capreolus</i>	3
Myxomatosis	Rabbit	<i>Oryctolagus cuniculi</i>	18
Pasteurellosis	Fallow deer	<i>Dama dama</i>	3
Pseudotuberculosis	Fallow deer	<i>Dama dama</i>	3
Pseudotuberculosis	European brown hare	<i>Lepus europaeus</i>	3
Pseudotuberculosis	Hedgehog	<i>Erinaceus europaeus</i>	1
Pseudotuberculosis	Hazel hen	<i>Tetrastes bonasia</i>	1
Pseudotuberculosis	Hooded crow	<i>Corvus corone cornix</i>	1
Pseudotuberculosis	Roe deer	<i>Capreolus capreolus</i>	2
<i>S. enterica</i> subsp. 4,5:-1,5	Great spotted woodpecker	<i>Dendrocopos major</i>	1
<i>S. Duesseldorf</i>	Wolf	<i>Canis lupus</i>	2
<i>S. enterica</i> subsp. diarizonae	Moose	<i>Alces alces</i>	2
<i>S. enterica</i> subsp. diarizonae	Otter	<i>Lutra lutra</i>	3
<i>S. Enteritidis</i>	Hedgehog	<i>Erinaceus europaeus</i>	16
<i>S. Typhimurium</i>	Badger	<i>Meles meles</i>	1
<i>S. Typhimurium</i>	Brown bear	<i>Ursus arctos</i>	2
<i>S. Typhimurium</i>	Bullfinch	<i>Pyrrhula pyrrhula</i>	10
<i>S. Typhimurium</i>	Hedgehog	<i>Erinaceus europaeus</i>	2
<i>S. Typhimurium</i>	Lynx	<i>Lynx lynx</i>	1
<i>S. Typhimurium</i>	Otter	<i>Lutra lutra</i>	1
<i>S. Typhimurium</i>	Siskin	<i>Carduelis spinus</i>	5
<i>S. Typhimurium</i>	Herring gull	<i>Larus argentatus</i>	1
<i>S. Typhimurium</i>	Ural owl	<i>Strix uralensis</i>	1
<i>S. Typhimurium</i>	Long-tailed field-mouse	<i>Apodemus sylvaticus</i>	1
Sarcoptic mange	Lynx	<i>Lynx lynx</i>	11
Sarcoptic mange	Red fox	<i>Vulpes vulpes</i>	9
Sarcoptic mange	Wolf	<i>Canis lupus</i>	2
Sarcoptic mange	Wild boar	<i>Sus scrofa</i>	1
Toxoplasmosis	European brown hare	<i>Lepus europaeus</i>	1
<i>T. nativa</i>	Raccoon dog	<i>Nyctyrectes procyonides</i>	1
<i>T. britovi</i> <sup>A</sup>	Wild boar	<i>Sus scrofa</i>	4
<i>T. nativa</i> <sup>A</sup>	Wild boar	<i>Sus scrofa</i>	1
<i>T. nativa</i>	Brown bear	<i>Ursus arctos</i>	1
<i>T. nativa</i>	Lynx	<i>Lynx lynx</i>	3
<i>T. nativa</i>	Wolverine	<i>Gulo gulo</i>	3
<i>Trichomonas</i>	Feral pigeon	<i>Columba livia</i>	4
<i>Trichomonas</i>	Green finch	<i>Chloris chloris</i>	11
<i>Trichomonas</i>	Bullfinch	<i>Pyrrhula pyrrhula</i>	2
<i>Trichomonas</i>	Siskin	<i>Carduelis spinus</i>	1
<i>Trichomonas</i>	Wood pigeon	<i>Columba palumbus</i>	1

<sup>A</sup> Two species, *T. britovi* and *T. nativa* were detected in one sample.

# 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* that are tested for antimicrobial susceptibility. These latter samples are also screened for ESBL-producing *E. coli*. At irregular intervals, samples of meat from broilers or pigs are cultured

for *E. coli* and *enterococci*, that are tested for susceptibility. The meat samples are also screened for ESBL-producing *E. coli*.

In addition to this mandatory monitoring Svarm is complemented with data on resistance for clinical isolates of bacteria from the routine testing of clinical submissions at 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 farm animals. Svarmpat is run in cooperation with Farm Animal Health 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](http://www.folkhalsomyndigheten.se) or at [www.sva.se](http://www.sva.se).

## SUMMARY SVARM 2014

The situation in Sweden regarding antibiotic resistance in bacteria from animals is favourable when seen in an international perspective. This confirms that the Swedish strategies to promote rational use and to contain antibiotic resistance in bacteria from animals have been effective.

### *Antibiotic consumption in veterinary medicine*

There are indications that the data on sales from Swedish pharmacies are less complete than before the reregulation of the Swedish pharmacy market in 2009. This problem probably mainly affects the sales of antibiotics for parenteral use, but because such drugs make up at least 70 percent of the overall consumption the magnitude of overall trends from 2010 cannot be assessed with certainty. The overall consumption of antimicrobials has decreased gradually since the mid-1990s, and there has also most likely been a true decrease since 2010.

Products for oral medication of individual animals and oral medication of groups of animals via feed or water are less likely to be affected by the lack of completeness in the data. Major downward trends are noted from 2010 to 2014 for both of these categories (by 32 percent and 55 percent, respectively).

*Extended spectrum beta-lactamase (ESBL) producing Enterobacteriaceae*

In animals, ESBL-producing Enterobacteriaceae occurs both as gut colonization and as clinical isolates, mainly from wounds or from the urogenital tract. The occurrence is relatively low, with the exception of broilers where ESBL-producing *E. coli* is isolated from a large proportion of the caecal samples. However, there has been a significant decrease in the occurrence in broilers and the proportion of positive samples is now comparable to the situation in 2010 when the problem was first discovered.

*Methicillin resistant Staphylococcus aureus (MRSA)*

The occurrence of MRSA in animals in Sweden is still low, and this limits the spread from animals to humans. In 2014, MRSA was not detected in a screening of nucleus and multiplying pig herds. MRSA was found sporadically in horses, dogs, cats, cattle, and hedgehogs in 2014. In companion animals, the same types of MRSA as in humans dominate indicating a human source of MRSA in these animals. In horses, livestock-associated MRSA CC398 is most common.

*Methicillin resistant Staphylococcus pseudintermedius (MRSP)*

In 2014, 39 cases of MRSP were reported in dogs (36 cases), cats (2 cases), and horses (1 case). The number of cases reported yearly has declined since 2009 when 130 cases were reported. No human cases were reported in 2014, but MRSP is not generally notifiable to the authorities.

*Resistance in zoonotic pathogens*

*Salmonella* is rare in animals in Sweden, and few incidents involve antibiotic-resistant strains. Strains with ESBL-resistance have never been found, and resistance to fluoroquinolones is rare. Invasive infections in humans are mainly caused by other *Salmonella* serovars than those found in

animals and isolates are often quinolone resistant. Animals in Sweden is therefore an unlikely source of *Salmonella* causing these infections.

*Campylobacter* from animals in Sweden are mostly susceptible, and for example resistance to erythromycin is most uncommon. Animals in Sweden are, therefore, an unlikely source for the highly resistant *Campylobacter* seen in isolates from humans.

Infections caused by *Salmonella* or *Campylobacter* are usually not treated with antibiotics, neither in humans nor in animals. In humans, this means that data on antibiotic resistance is mainly available from a small number of invasive infections.

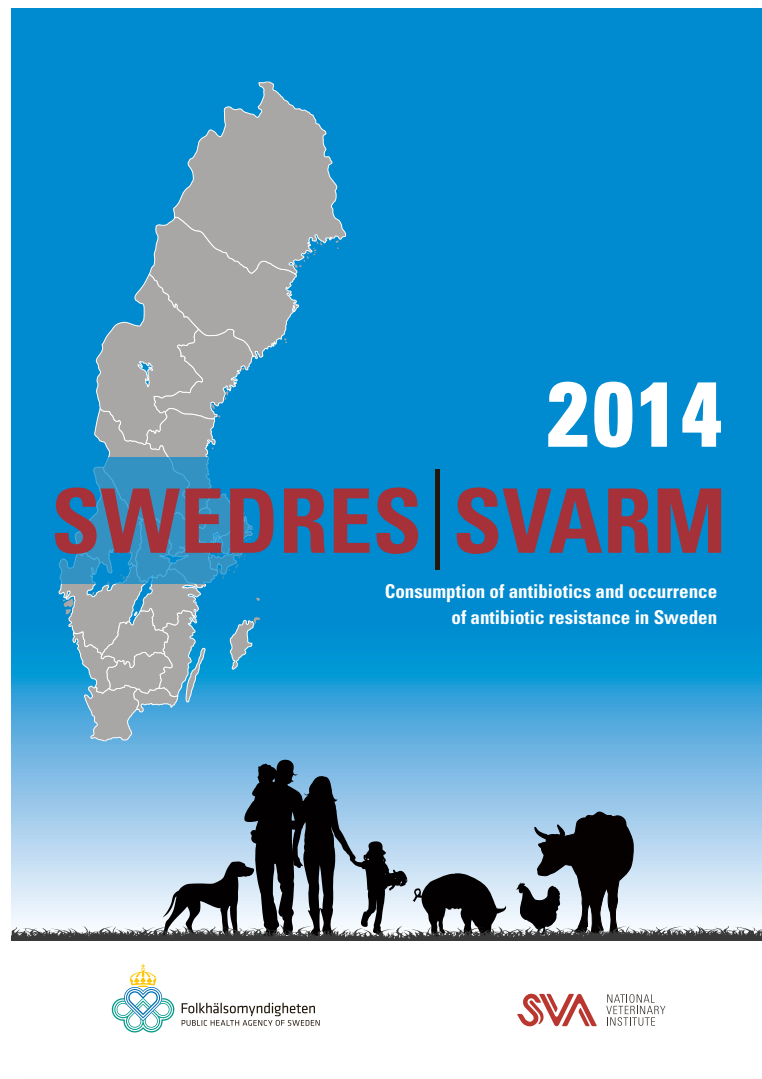
*Resistance in animal clinical isolates*

Bacteria causing clinical disease in animals are mostly susceptible to antibiotics relevant for treatment. Respiratory pathogens from farm animals and horses are generally susceptible to benzylpenicillin, but penicillin resistance is common in *S. pseudintermedius* from dogs and it occurs in *S. aureus* from horses and *Staphylococcus felis* from cats. Resistance in *E. coli* occurs in all animals but is most prominent in enteric isolates from young calves. Susceptibility testing for guidance in antibiotic therapy is warranted, especially for staphylococci and *E. coli*.

*Resistance in indicator bacteria from healthy animals*

Antibiotic resistance in *E. coli*, *E. faecalis*, and *E. faecium* from the intestinal flora of healthy animals serves as an indicator for the presence of resistance in an animal population. Also, the prevalence of acquired resistance in such commensal bacteria indirectly indicates the magnitude of the selective pressure from the use of antibiotics in an animal population. Prevalence of resistance in indicator bacteria from animals in Sweden is low, and the situation is favorable in an international perspective.

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.



Download the report at [www.folkhalsomyndigheten.se](http://www.folkhalsomyndigheten.se) or at [www.sva.se](http://www.sva.se)

