Zoonoosikeskus
Zoonosis Centre

Zoonoses in Finland in 2000–2010

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What is the Zoonosis Centre?

The Zoonosis Directive of the European Parliament requires that the Member States ensure co-operation related to zoonoses, food-borne outbreaks and antimicrobial resistance between veterinary, food safety and healthcare authorities. Finland's co-operation body is the Zoonosis Centre, which was established in 2007.

The Zoonosis Centre is a network consisting of experts from the Finnish Food Safety Authority Evira and the National Institute for Health and Welfare THL. The monitoring of zoonoses, food-borne outbreaks and antimicrobial resistance is co-ordinated through the Zoonosis Centre, and it organises information gathering and publishing of monitoring results. The Centre also participates in outbreak investigations, communications concerning zoonoses and related training activities.

The Centre acts as a national contact point with international zoonosis experts. The key contact points in the EU are the European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC). The Zoonosis Centre participates in the planning, gathering of material and reporting in jointly agreed zoonosis monitoring projects in the EU.

The Zoonosis Centre carries out co-operation, among others, with the Nordic zoonosis centres.

Table of Contents

Table of Contents

1. Terminology and abbreviations

Epidemiology	The study of health and disease and the related factors in a population
Outbreak	A group of disease cases clearly distinguished from the background
Occurrence	A general term related to the frequency of a disease or the cause of disease, which can be described, e.g. as incidence or prevalence
Incidence	The number of new cases in a specified population at a specified time
Cross contamination	Contamination of food with microbes transferred from other food, raw materials or the environment
Food-borne or water-borne outbreak	Two of more people being taken ill after eating or drinking the same food or water
Prevalence	A confirmed number of people being taken ill or the cause of disease in a specified population at a given time or period of time
Zoonosis	An infectious disease transmitted from vertebrates to humans, and vice versa
EVIRA	Finnish Food Safety Authority
THL	National Institute for Health and Welfare

2. Introduction

Zoonosis is an infectious disease transmitted from vertebrates to humans, and vice versa. The disease may be completely asymptomatic in humans and animals or it may cause symptoms of various degrees or even result in death. A human may be infected with a zoonotic agent in different ways. One of the key means of transmission is infection through food, especially foodstuffs of animal origin. Zoonosis may also be transmitted from direct contact with an animal or indirectly, e.g. from animal faeces. Infection can also be transmitted by insects. Animals can become infected by other animals, humans, feedstuff, or the environment in the same way as humans. Finland has traditionally invested a great deal in the prevention of zoonoses. Risk management has been found to be easiest and cheapest in the primary production stage of the food chain. Hygienic handling of food and salmonella screening of employees in the food industry are also an important part of prevention work.

Due to our geographical location, sparse population and positive attitude towards the prevention of diseases, it has been easy to restrict the level of infectious diseases in animals. In Finland, animals do not currently have serious zoonoses, such as bovine tuberculosis, brucellosis or rabies, which cause considerable problems in many other countries. On the other hand, important zoonoses in our country include salmonellosis, campylobacteriosis, listeriosis and yersiniosis, as well as trichinosis that requires extensive monitoring resources in meat inspection. The EHEC bacterium has emerged as a new pathogen during the reporting period. To reduce the detriment caused by these zoonoses, we need constant co-operation between various authorities, research institutes and industries.

This report consists of the zoonosis monitoring data published on the website of zoonoosikeskus.fi in 2011, and the case studies have been gathered from Evira's annual publications: Foodborne and waterborne outbreaks in Finland, and Animal diseases in Finland. The purpose of the report is to provide summarised information about the causes of zoonosis in humans, food, animals and feedstuff in Finland in 2000–2010. The statistics produced by the monitoring activities in Finland in accordance with the Zoonosis Directive 92/117/EC have been used as the information sources. Other information sources include the monitoring and research information of institutes that have taken part in the compiling of the website. The purpose of monitoring zoonoses and their causes is to help the authorities to plan and implement activities promoting public health, food safety and the health of production animals, and to assess their effectiveness.

The report deals with pathogens with a significant zoonosis in our country either as causing diseases in humans and/or due to the substantial activities aimed at preventing them. Moreover, descriptions of the events and observations related to zoonoses significant to Finland, taken place during the period in question, have been gathered in the report.

The report is a follow-up report on the publication Zoonoosit Suomessa 1995–1999 (In English Zoonoses in Finland in 1995–1997). The working group that drew up the report would like to thank the numerous experts for their input in the production of the data reported. The Zoonosis Centre team hopes that the report will be able to provide an easy-to-read and comprehensible overall picture of Finland's zoonosis situation in the first decade of the 2000s.

3. Summary

In the first decade of the 2000s, the most significant bacterial zoonoses of the population were Campylobacter, Salmonella and Yersinia infections. Listeria and EHEC infections were more uncommon, but their clinical profile was serious at times. Of viruses, especially the significance of norovirus as the cause of food-borne outbreaks has emerged in comparison with the previous decade. Of the zoonoses spread by vectors and wild animals, especially the number of borreliosis cases rose during the decade.

There were several carrot-derived food-borne outbreaks caused by the bacterium *Yersinia pseudotuberculosis* in Finland in the first decade of the 2000s, the most serious epidemic being in 2006. Moreover, in 2009 there was a feed-derived *Salmonella* Tennessee epidemic in production animals, which was extensive on the Finnish scale. Although Finland has been rabies free, it was necessary to launch prevention measures due to imported animals that carried the disease. Rabies was detected in animals imported into Finland from Estonia in 2003 and from India in 2007.

Over the course of the decade, the bacterium *Coxiella burnetii*, which causes Q-fever, was detected in Finnish cattle for the first time, as well as the swine influenza virus in pigs.

The monitoring activities of zoonoses became more effective over the course of the decade, especially along with systematic monitoring of the bacterium Campylobacter in poultry and the bacterium VTEC in cattle. During the decade, food surveys focused mainly on Listeria and Salmonella bacteria. Research activities also produced new information about the occurrence of zoonoses in animals and food.

4. Monitoring activities

4.1. In humans

The National Infectious Diseases Register maintained by the National Institute for Health and Welfare is also a key tool in the surveillance of zoonoses. Based on the notifications of infectious diseases by doctors, dentists and microbiology laboratories, the register contains detailed statistics on infectious diseases since 1995. Information, for example, on infections and outbreaks caused by Salmonella, Listeria and Yersinia and on detected vector-borne infections is gathered in the register. The National Institute for Health and Welfare confirms the key findings.

4.2. In food

Monitoring of the causes of zoonoses in the food chain is mainly based on statutory monitoring programmes, within the scope of which the Finnish Food Safety Authority Evira systematically collects information, for example, on the occurrence of Salmonella, Campylobacter and VTEC bacteria. Meat inspection and other monitoring by the authorities, in-house control programmes and separate surveys are also key tools in the monitoring of zoonoses in food. In meat inspection, for example, the occurrence of trichinella and echinococcus parasites is monitored. Other important research areas in foods include occurrences of the Listeria and Yersinia bacteria. Evira provides guidelines for the collection and study of samples, partly carries out the laboratory diagnostics work, and always confirms the findings.

4.3. In animals

Although many of the zoonoses found in other countries even in humans do not occur in animals in Finland, for example, the situation with bovine tuberculosis, brucellosis and Echinococcus multilocularis is monitored constantly to be able to ensure a disease-free status in the country. Regular monitoring is also carried out, for example, to detect rabies and avian influenza viruses, as well as BSE in animals. Separate surveys and reports are also a key tool in the monitoring of the occurrence of zoonoses in animals. The Finnish Food Safety Authority Evira provides guidelines for the collection of samples and carries out the laboratory diagnostics work also with respect to these studies.

4.4. In feed

The monitoring of the occurrence of the causes of zoonosis in animal feeds is based on statutory monitoring programmes, within the scope of which the Finnish Food Safety Authority Evira systematically gathers information, e.g. about the occurrence of Salmonella and banned animal-derived protein in feeds. Evira always confirms the findings.

5. Diseases caused by bacteria

5.1. Borreliosis

Borreliosis is a disease caused by the spirochaete bacteria belonging to the genus *Borrelia*. Borrelia multiply especially in the bloodstream of small rodents and the white-tailed deer. The incidence of these reservoir animals plays a key part in the occurrence of the disease.

The vectors of the disease are mainly ticks of the genus *Ixodes ricinus*, and the bacteria multiply in the intestines of this tick. The *Borrelia* genus includes several bacterial species that cause diseases in animals and humans. *B. bugdorferi sensu lato* is found in Finland. The disease caused by *B. burgdorferi sensu lato* is known by the name of Lyme borreliosis or Lyme disease.

5.1.1. Borreliosis in humans

In humans, Borrelia may cause an infection, which is called borreliosis or Lyme disease. The disease is transmitted via a tick bite. The number of Borrelia cases has risen in the 2000s. The highest number of cases by far has been in Southern Finland and the Åland Islands where the incidence is very high even on the international scale. Elsewhere, the infections have concentrated on Eastern and Western Finland. Individual cases have been found even up in Lapland. Borreliosis is most common in the autumn, between August and November.

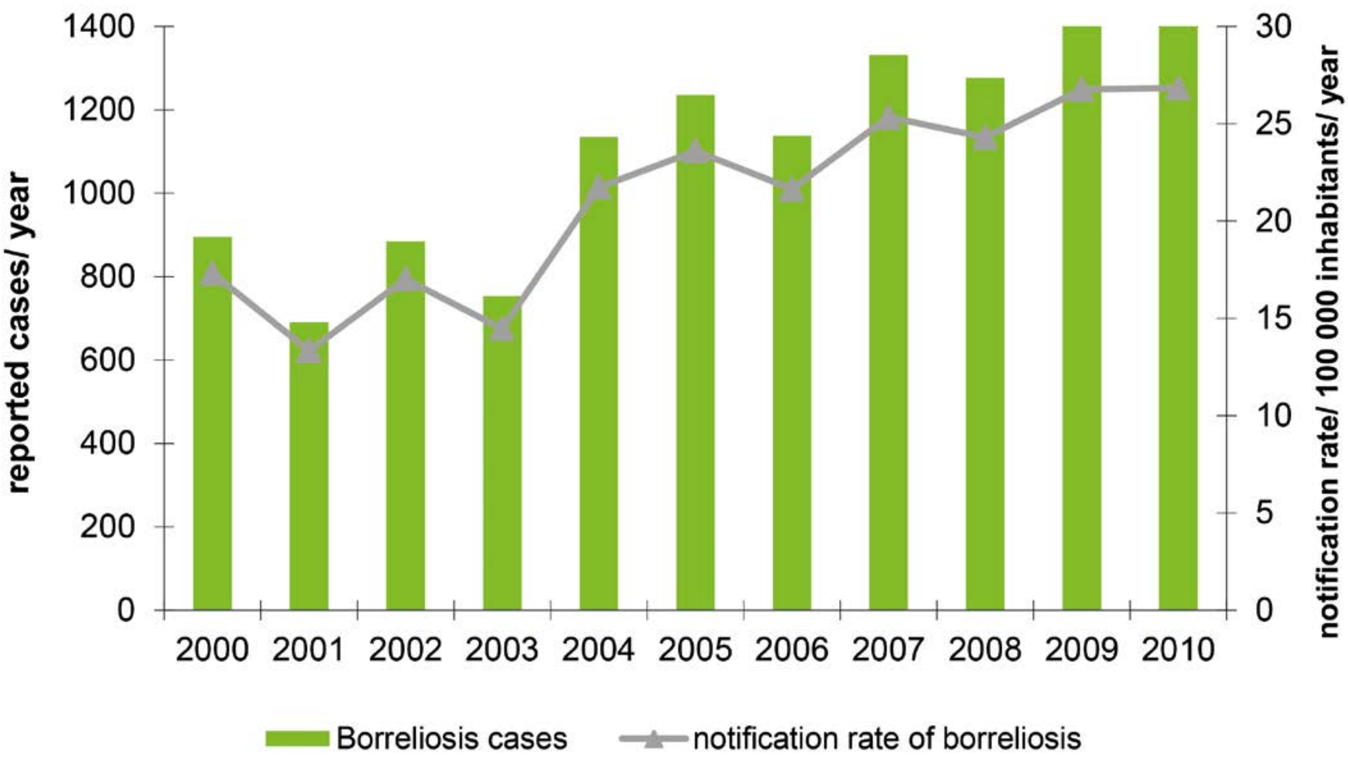


Figure: *Reported borreliosis cases in the population in 2000–2010. (Source: National Infectious Diseases Register, THL)*

5.1.2. Borreliosis in animals

Borreliosis has been detected in many animal species, such as dogs, cats, horses, cattle and sheep, however, mostly in dogs and horses. Borreliosis is not an animal disease that is subject to a control programme in Finland. The disease is not spread from infected animals without being transmitted by a tick.

In the 2000s, antibodies of the Borrelia were found every year in animal samples delivered to Evira for examination. According to research statistics, an increasing number of Borrelia antibodies has been found in dogs since 2003.

Based on statistics, however, it is not possible to draw conclusions on the actual occurrence of antibodies in dogs. Borrelia antibodies have also been studied in horses: antibodies have been found in about 13% of the horses that have been tested each year.

5.2. Botulism

A disease caused by toxins produced by the bacterium *Clostridium botulinum* is called botulism.

The spores of the bacterium *C. botulinum* are normally present in the soil and waterways. The spores of the bacteria are particularly resistant. In favourable conditions, the spores develop into bacteria that produce toxins. Toxins enter the system, e.g. through contaminated food.

The bacteria *C. botulinum* can be divided into seven different types (A-G) on the basis of the toxins they form.

5.2.1. Botulism in humans

Botulism is a poisoning caused by *C. botulinum* bacterial toxins may result in death if left untreated. Only the types A, B, E and F of the botulin

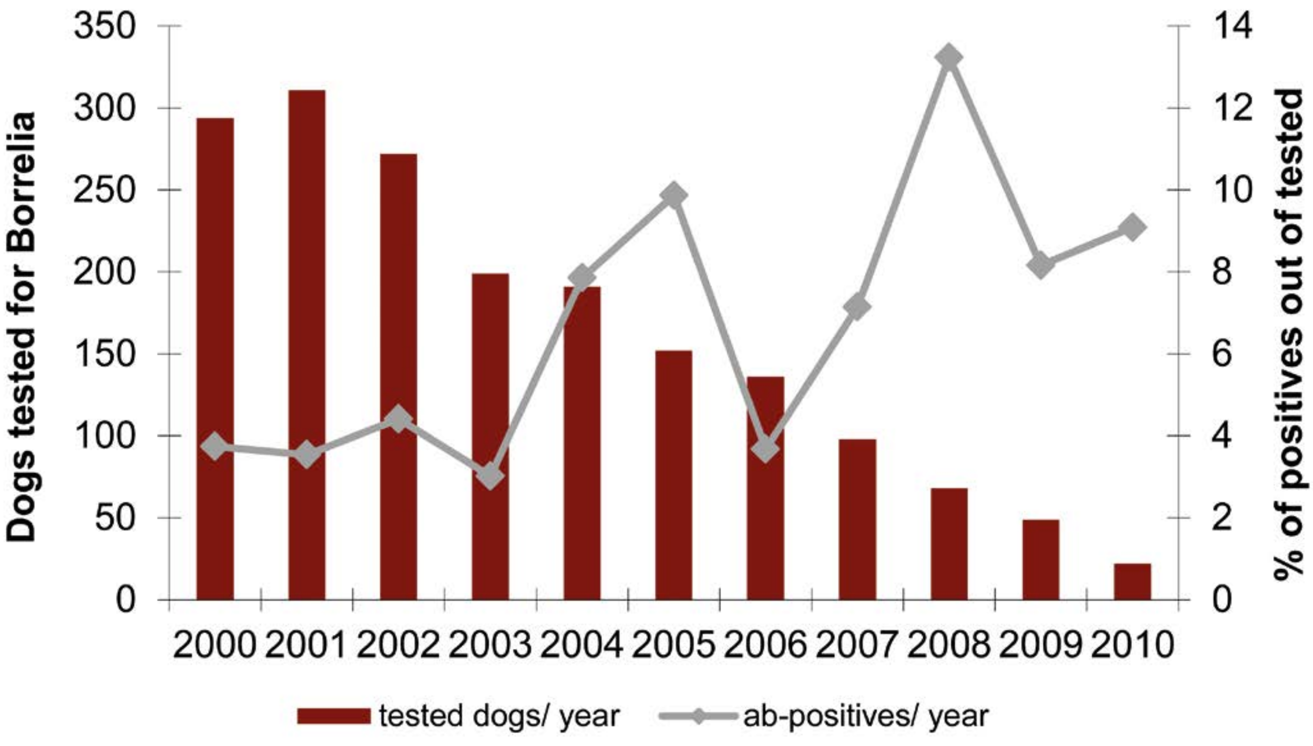


Figure: *Borrelia antibody investigations on dogs in 2000–2010 (Source: Diagnostics of animal diseases, Evira)* toxins cause illness in humans. The toxins of types C and D have not cased human food borne disease. The most common source of infection is food, which is a so-called botulism food poisoning. Infant botulism occurs in children under the age of one year, and honey has been linked as the source of infection. Wound botulism is the rarest form of botulism. Bacteria start to produce spores in the wound from where the toxin can spread elsewhere in the system.

Botulism is uncommon in Finland: between 2000 and 2010 there were two cases of botulism poisoning.

5.2.2. Clostridium botulinum in food

As the spores of *C. botulinum* are normally present in the soil and waterways, it is possible for the bacterium to end up in the raw materials of food, such as fresh fish. The toxin that causes botulism is produced in food during the bacterial growth stage when the food is stored in temperatures of over 3 degrees in oxygen-free conditions. The most common sources of infection of botulism food poisoning are salted and dried meat products, canned food and hot-smoked vacuum-packed fish.

The occurrence of bacterial spores, bacteria or toxins produced by them in food products is not systematically monitored

5.2.3. Botulism in animals

Botulism can be contracted by several animals, such as cattle, sheep, horses, birds, minks and foxes. Outbreaks in natural waterfowl are not uncommon. Dogs and pigs are not susceptible to the disease and there are no reports of cats contracting the disease.

Regardless of the animal species, the clinical profile follows a similar pattern. Toxins produced by the bacterium act as a neurotoxin, usually resulting in paralysis. Symptoms develop rapidly, often resulting in the death of the animal. Animals are usually infected through feed or from soil or beddings containing bacterial spores.

In Finland, botulism in poultry was detected for the first time in 2009. In the detected cases, the type of botulism in question was *C. botulinum* type C, which is regarded as harmless to humans. In 2002, a large number of farmed blue foxes contracted botulism and died as a result of contamination of feed. The types of botulism in question were types C and D of *C. botulinum*, which are regarded as harmless to humans.

Case report – botulism with a probable source of hot-smoked whitefish

In July 2006, *C. botulinum* caused on outbreak with two members from the same family falling ill. The food vehicle was probably hot-smoked whitefish purchased prepacked from the local supermarket. The use-by date of the fish was one week from the time of consumption. The country of origin of the fish was Canada, and it had probably been delivered frozen to Finland. Defrosting and smoking, as well as the packing of the end product took place at a Finnish plant.

In early September 2009, botulism caused by *C. botulinum* was detected in France in three members of the same family. The source was suspected to be hot-smoked whitefish purchased from Finland. The vacuum-packed fish had been bought in a retail outlet in Eastern Finland at the end of August, transported by plane to France by a private person and consumed two weeks later on the eat-by date. During the journey, the fish had been stored in a cool box in unknown temperatures for 14 hours and after that at home in the refrigerator. Before consuming, the fish had not been heated. None of the fish consumed by those who were taken ill was left over for examination purposes. In studies carried out in Finland on a sample of fish from the same batch, smoked one day later, *C. botulinum* bacteria was not detected by a PCR test. In inspections carried out by the food control authorities, no defects were found in the retail outlet that sold the fish or in the fishery.

5.3. Brucellosis

Brucellosis is a disease caused by bacteria in the *Brucella* genus. The *Brucella* genus includes several species that cause diseases to animals and humans. These species have one or two principal host animal species and several other occasional host species. Of the bacteria in the *Brucella* genus, *B. abortus* causes brucellosis in cattle. Brucellosis in sheep and goats is caused by *B. melitensis* while *B. suis* causes brucellosis in pigs and *B. canis* in dogs. The zoonotic significance of other bacteria in the *Brucella* genus is insignificant or there is no absolute certainty about it.

5.3.1. Brucellosis in humans

The bacteria in the *Brucella* genus can cause an infection in humans. The disease is transmitted by direct contact with domestic or wild animals or through contaminated food, such as unpasteurised milk. The bacteria may infect humans especially when handling dead foetuses of infected animals.

In Finland, there have been no domestic cases of brucellosis in years. However, in the 2000s, there were 0–2 infections of *Brucella melitensis* infections per year that were contracted abroad.

5.3.2. Brucella in food

Brucella bacteria may be shed in milk if the dairy animal carries the bacteria. *Brucella* bacteria are destroyed effectively during pasteurisation.

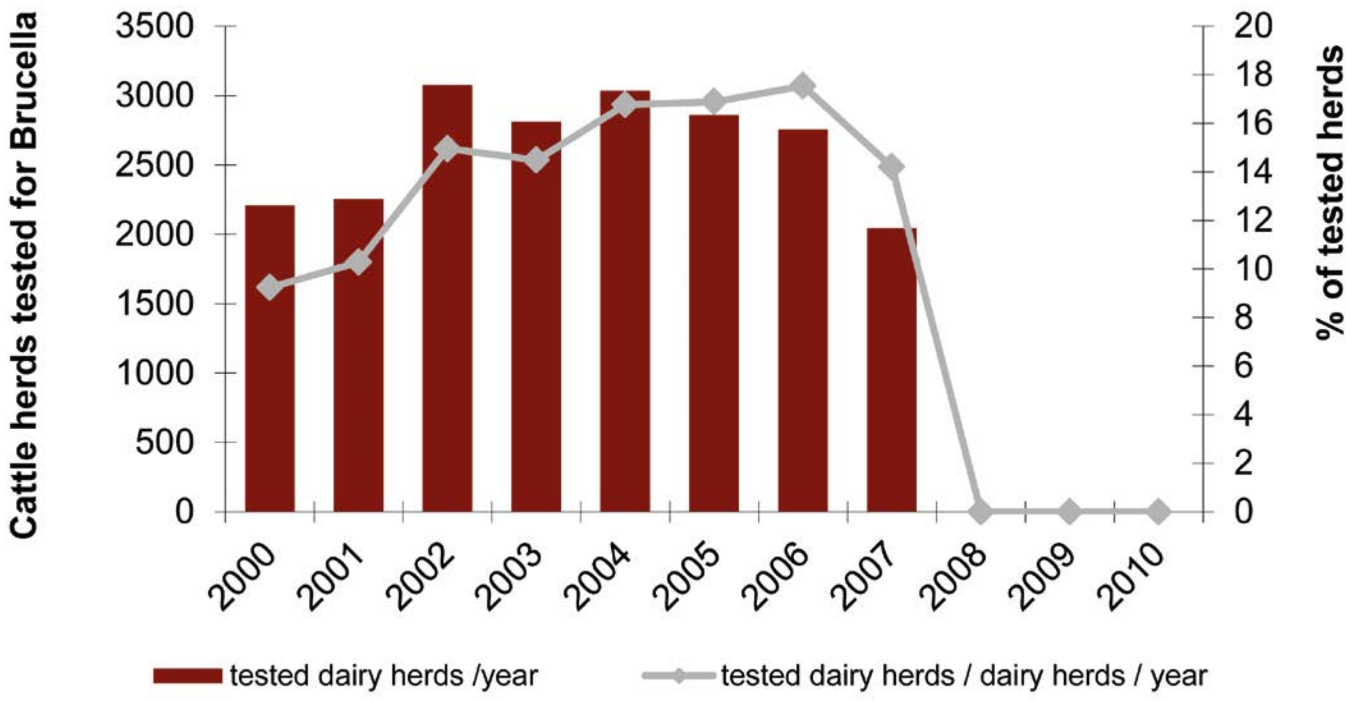


Figure: *Monitoring of Brucella abortus in dairy cattle in the 2000s. (Source: Programmes for the prevention and monitoring of animal diseases, Evira; Farm Register (MATILDA), Tike)*

5.3.3. Brucellosis in animals

Brucella infections in animals are chronic. Usually the animals carry the infection throughout their lives. The general symptoms are not normally observed. The *Brucella* bacteria infect primarily the genitals, causing foetal death and problems with the beginning of gestation. The bacteria are shed in copious amounts along with the aborted foetus, afterbirth and womb secretions. Milk is another significant source of infection in animals.

The prevention of brucellosis in Finland was launched as early as in the 1920s. The last *Brucella abortus* infection in Finnish cattle was detected in 1960. *B.suis* and *B. melitensis* infections have never been diagnosed in Finland. *B. canis* was isolated in Finland for the first time in 2008 from a dog imported to Finland from abroad.

In the 2000s, monitoring of *Brucella* infections has mainly been based on the screening of antibodies in production animals, studies related to the artificial insemination of cattle and pigs, and investigations of clinically suspected disease cases.

From 1990 to 2008, *Brucella abortus* monitoring was based on the screening of bulk tank milk of dairy cattle, for which the cattle to be studied was selected with random sampling each year. The random sampling of dairy cattle ended in 2008, after which the focus of *Brucella* monitoring was aimed at abortion cases among cattle. The monitoring of beef breeding cattle focuses on suckler herds, with blood samples collected from animals sent for slaughter. No *Brucella* has been detected in Finnish cattle.

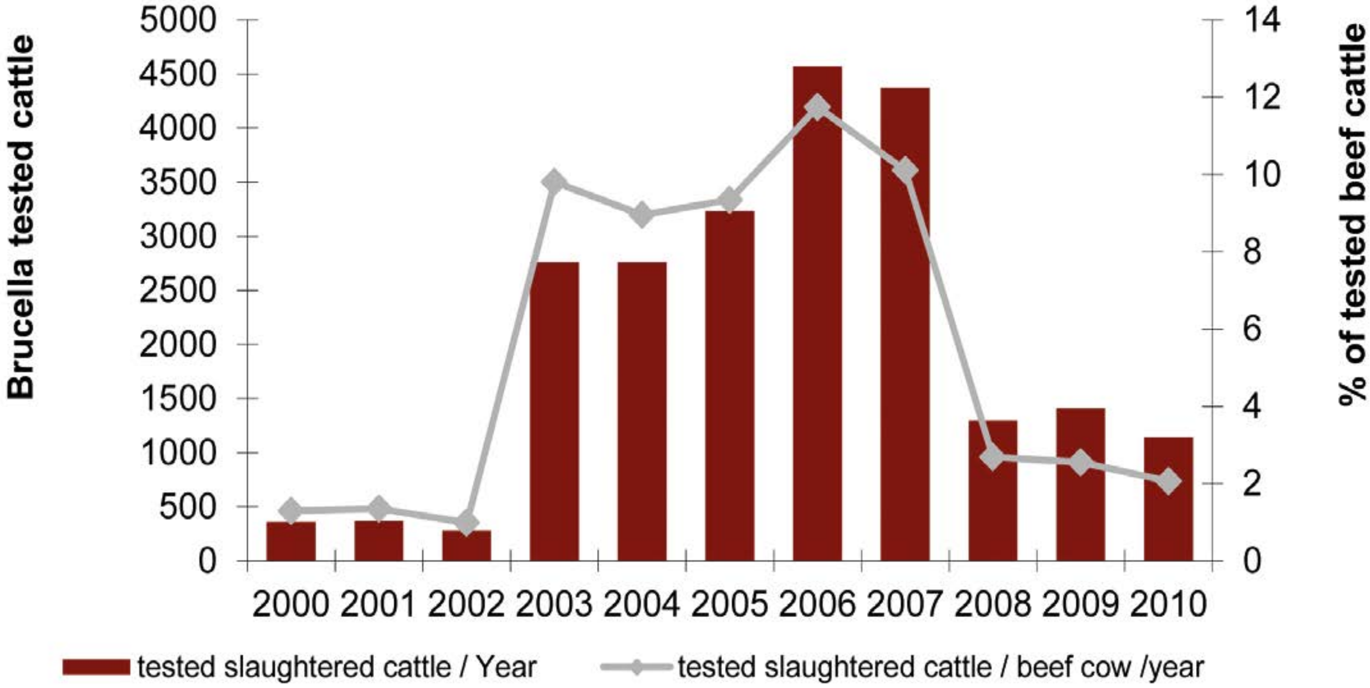
For the monitoring of *Brucella suis*, blood samples were collected from sows, fattening pigs and boars in connection with slaughter between 1994 and 2007. Since 2007, monitoring has focused on piggeries producing replacement breeding stock. Monitoring also covers blood samples collected from pigs at the farms of departure and sent to the artificial insemination centres, as well as the health control samples collected once a year from the pigs at artificial insemination centres.

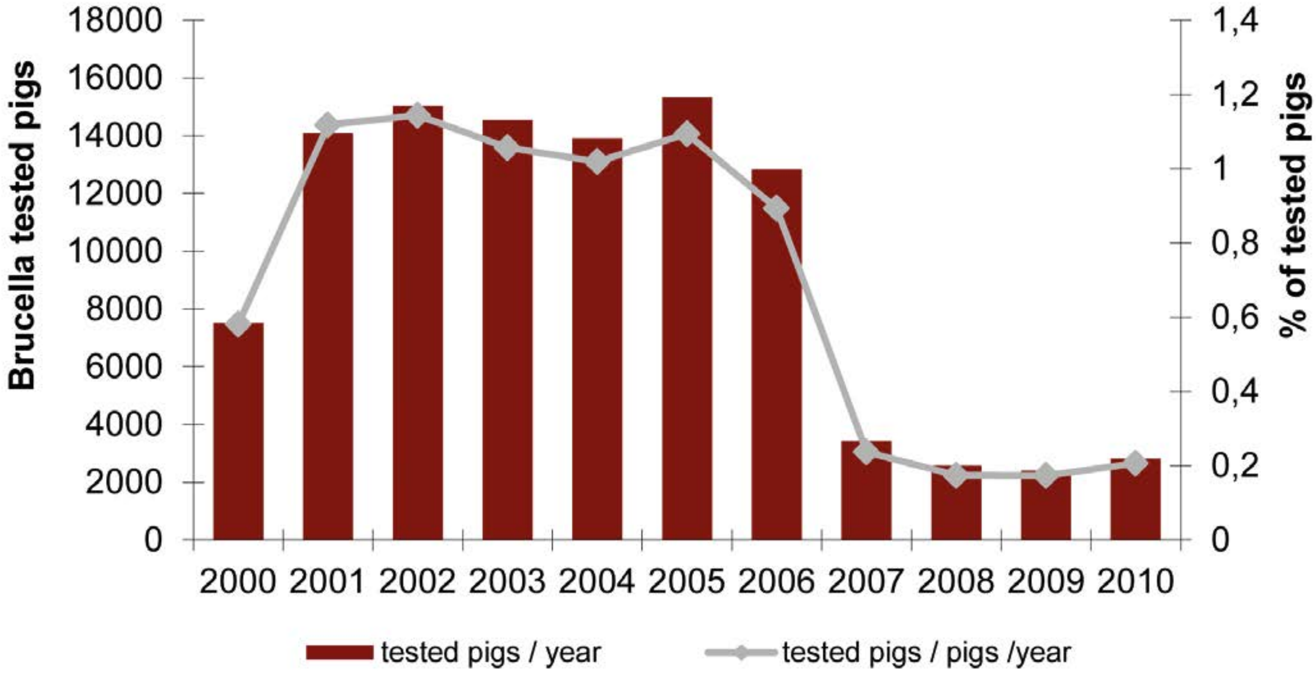
The monitoring of *Brucella melitensis* in sheep and goats is based on annual sampling from the blood samples gathered within the scope of the maedi-visna control programme. With respect to the samples of the control programme, the sampling covers all goat and some sheep samples. The monitoring has been carried out since 1994.

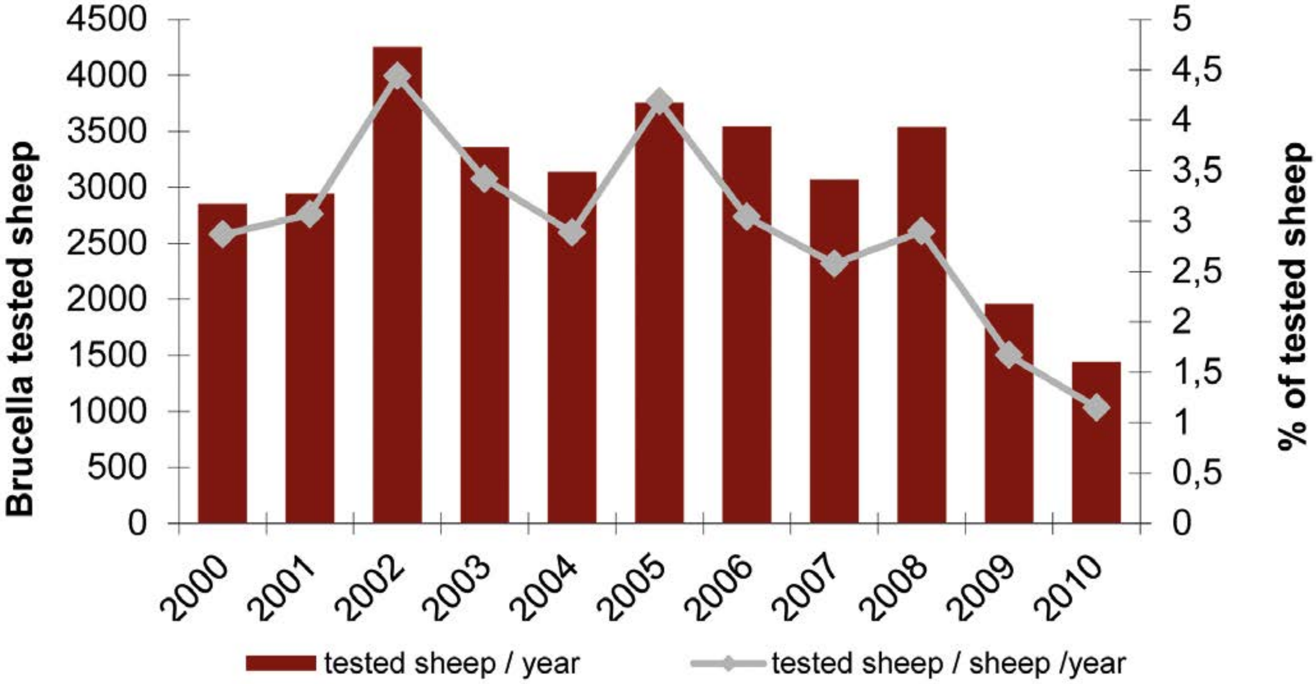
The monitoring results indicate that Finnish production animals are free of *Brucella* genus bacteria causing diseases in humans.

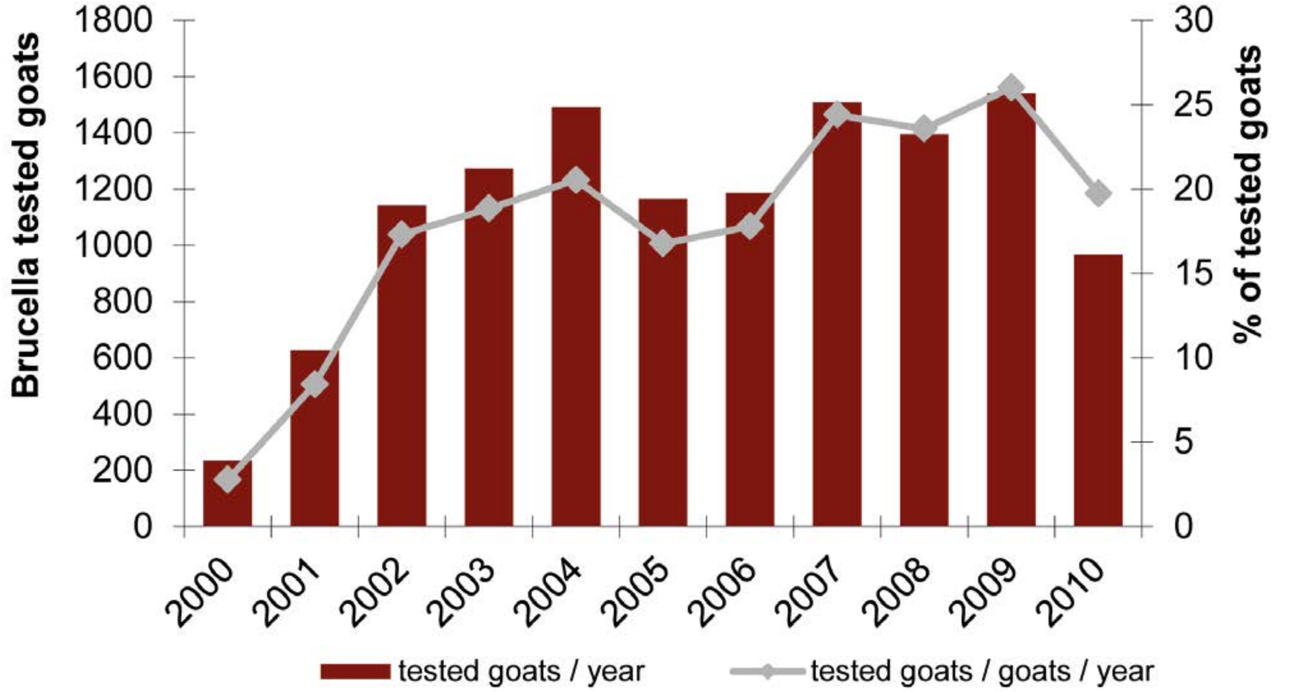
5.3.4. Significance of Brucella in Finland

Bacteria in the *Brucella* genus causing disease in humans are not present in production animals in Finland. The European Commission has declared Finland to be officially free of brucellosis of cattle (*B. abortus*), and that of sheep and goats (*B. melitensis*).


Brucella tested cattle
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
14
12
10
8
6
4
2
0
% of tested beef cattle
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
tested slaughtered cattle / Year
tested slaughtered cattle / beef cow /year


Brucella tested pigs
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1,4
1,2
1
0,8
0,6
0,4
0,2
0
% of tested pigs
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
tested pigs / year
tested pigs / pigs /year





Figures a-d *Brucella monitoring in beef cattle (a), pigs (b), sheep (c) and goats (d) in the 2000s. (Source: Programmes for the prevention and monitoring of animal diseases, Evira; Farm Register (MATILDA), Tike)*

5.4. EHEC / VTEC

Enterohaemorrhagic *Escherichia coli* (EHEC) is an *E. coli* bacterium strain, which produces vero-cytotoxin and causes a generally hazardous communicable disease in humans. The EHEC strain is a part of the more common group of coliform organisms, the VTEC, which produce verotoxins. VTEC bacteria are found among hundreds of *E. coli* serogroups, only some of which cause disease in humans. The most widely known and significant cause of outbreaks is *E. coli* O157:H7. The most common of the other serogroups, which have a collective name of VTEC non-O157, are O26, O91, O103, O111, O113, O121, and O145.

5.4.1. EHEC in humans

The most common sources of infection of the EHEC bacteria are food, drinking water or swimming water contaminated with the bacteria. It is also possible to be infected through the handling of an animal carrying the bacteria. EHEC has a low infective dose, and therefore it is highly contagious in close contact. A significant number of domestic infections found in Finland have been obtained through close contact between humans.

The number of EHEC cases found in Finland has remained stable over the past few years, and there have not been major epidemics caused by EHEC in the 2000s. A total of 10–20 microbiologically confirmed EHEC cases have been notified each year, the majority of which are infections obtained in Finland.

EHEC O157

In the 2000s, just over half of all EHEC infections and those of domestic origin were of serogroup O157. The bacterium of serogroup O157 caused a number of infections especially in 2005. Cattle have been proven to have been the source of infection of the bacterium with serogroup O157 in a few individual infections and one family outbreak in the 2000s.

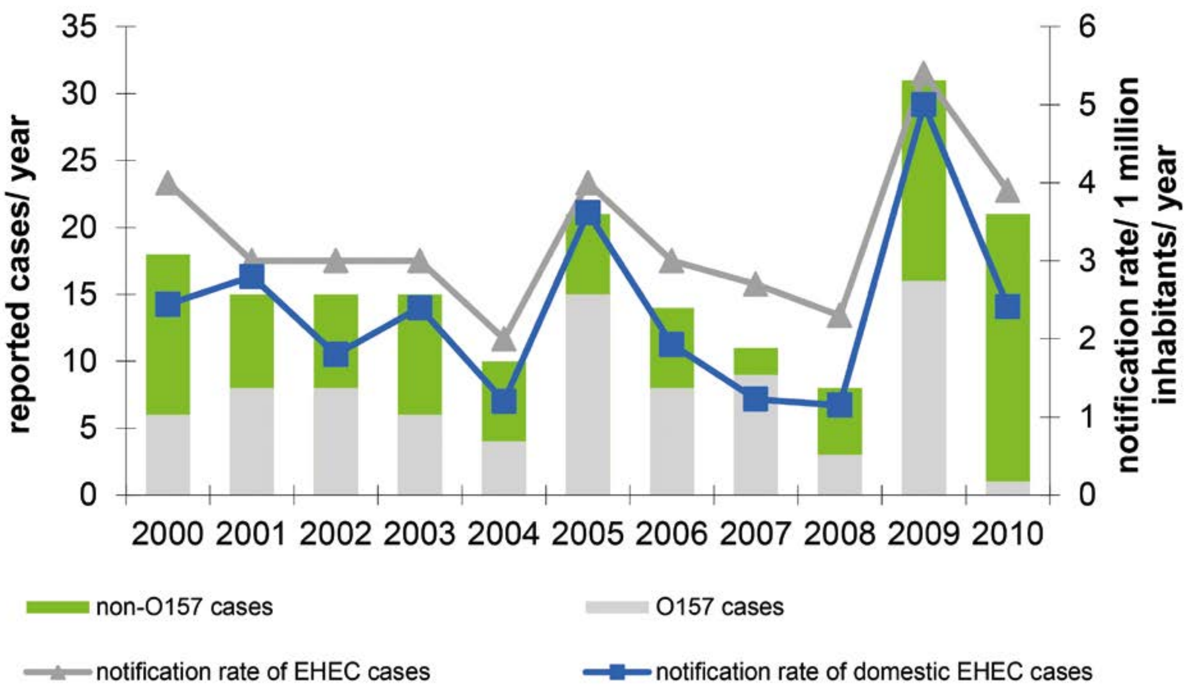


Figure: *Reported EHEC cases in the people 2000–2010 (Source: National Infectious Diseases Register, THL)*

EHEC non-O157

In the 2000s, the highest number of EHEC non-O157 infections occurred in 2005, 2009 and 2010. Of the domestic non-O157 serogroups, O26, O103, O121, O145 and O174 were found. In the 2000s, cattle were suspected a number of times as the source of non-O157 EHEC infection.

5.4.2. VTEC in food

VTEC bacteria can end up in food or water through contamination by animals or the faeces of people carrying the infection, or via cross contamination. VTEC bacteria can end up in meat during slaughter and in milk during milking procedures. In Finland, EHEC infections have been proven or suspected to have been caused by unpasteurised milk, imported kebab meat and hamburgers.

In 2006, the occurrence of VTEC bacteria in minced meat was investigated. Of the studied batches of minced meat, 1% was found to contain serogroups of VTEC bacteria that have been connected with serious cases of haemolytic uraemic syndrome (HUS) in humans.

VTEC O157

The occurrence of VTEC O157 bacteria in food has been investigated in separate projects. In 2001, occurrence in minced meat used for the preparation of kebab meat was studied. In 2003, occurrence in beef and in raw meat products containing beef was investigated. In 2004, raw milk cheeses from Finland were studied. The VTEC O157 bacterium was not found in any of the studies.

5.4.3. VTEC in animals

Production animals

VTEC does not usually cause disease in animals, but they are asymptomatic carriers of the bacteria. The bacteria have been isolated from cattle and other ruminants and animal species. Cattle are regarded as the main reservoir of the VTEC bacteria. In fattening farms, the occurrence of VTEC bacteria is regarded to be greater than in dairy farms. The occurrence of VTEC during the warm season is more common than in the winter. In several human cases, it has been possible to demonstrate similar EHEC serogroup bacteria in the patients and the suspected cattle animals.

	Year	Number of samples analysed	**VTEC O157 (%)**
Meat and meat products			
beef	2003	180**	0
raw beef preparation	2003	44**	0
minced meat / kebab meat	2001	220*	0
Dairy products			
▪ **Cheeses**			
fresh, raw milk, cow	2004	15***	0
fresh, raw milk, goat	2004	13***	0
white mould	2004	1***	0

*of both Finnish and foreign origin; ** from intercommunity market trade; ***Finnish origin

***Table:** Occurrence of VTEC O157 bacterium in some foodstuffs studied in Finland. (Source: Food investigation and monitoring projects, Evira)*

If an EHEC infection detected in humans is connected to a cattle herd, the herd is tested for infection. On the traced farm, the infection pressure from animals to humans and between animals is reduced with hygienic measures.

The occurrence of VTEC in Finnish slaughter cattle was studied in a research project in 2003. VTEC bacteria were found in 30% of faecal samples and in 11% of carcass surface swabs. The highest number of bacteria was found in August–October. Among the serogroups found, in addition to O157 there were also other types that are known to cause EHEC infection in humans, such as O91, O103 and O113.

The prevalence of VTEC O157 bacteria in Finnish slaughter cattle was studied in research projects in 1997 and 2003. Since 2004, the prevalence of VTEC O157 bacteria in Finnish slaughter cattle has been monitored systematically as part of the in-house control of slaughterhouses.

According to studies, VTEC O157 bacteria were found in 1.3% of the tested bovine animals in 1997 while the corresponding result in 2003 was 0.4%. Since 2004, the VTEC O157 bacteria have been found in 0.5–1.2% of the tested bovine animals at the annual level. Cattle carrying the VTEC bacteria have been found in all seasons, with the majority of findings being made in June–August. In the 2000s, the prevalence of the bacteria in slaughter cattle has not changed noticeably at the annual level.

The occurrence of the VTEC bacteria in cattle farms in 2004 was investigated in a separate research project. Of the 126 cattle farms included to the study, 5.5% were found to have VTEC O157 bacteria.

Since 2004, the VTEC O157 bacteria have been found in five to eighteen cattle farms each year through the in-house control programme of the slaughterhouse. Other VTEC types have not been found in the cattle farms within the scope of the EHEC control programme.

Wild animals

In Finland, no VTEC bacteria have been found in cervids, such as elks, deer or reindeer, or in birds.

5.4.4. Significance of EHEC in Finland

In the last few years, EHEC have been the fifth most common bacterium causing intestinal infections in humans in Finland. The majority of the infections are contracted in Finland, and a significant number of them are through human contacts. In Finland, cattle have turned out to be the key animal reservoir while in wild ruminants there is little indication of VTEC bacteria.

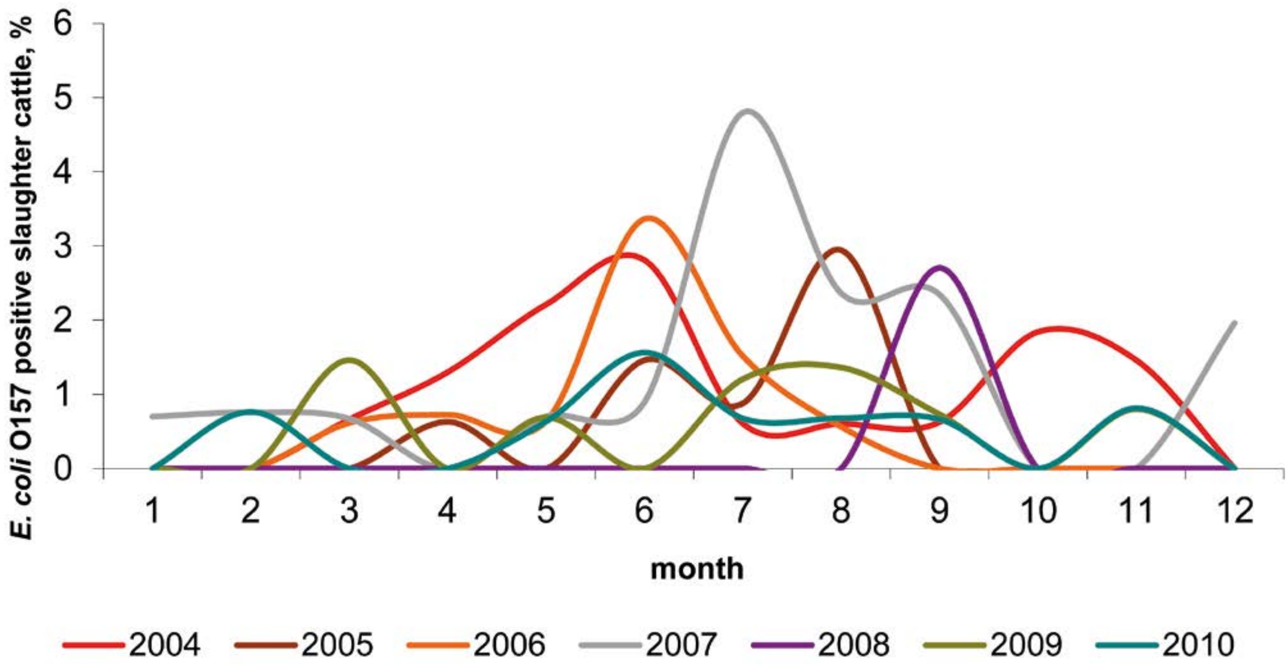


Figure: *The monitoring results of the prevalence of VTEC O157 bacteria in slaughter cattle in 2004–2010 (Evira)*

Case report – Food-borne outbreak caused by EHEC

In 2001, four young people became ill after dining in different kebab restaurants, and three of them were found to have EHEC serotype O157. The restaurants had used the same frozen, uncooked kebab skewers manufactured by a Dutch plant. Two of the meat batches contained O157 type bacteria, which had the same subtype as the bacterial strains isolated from three of the people who fell ill.

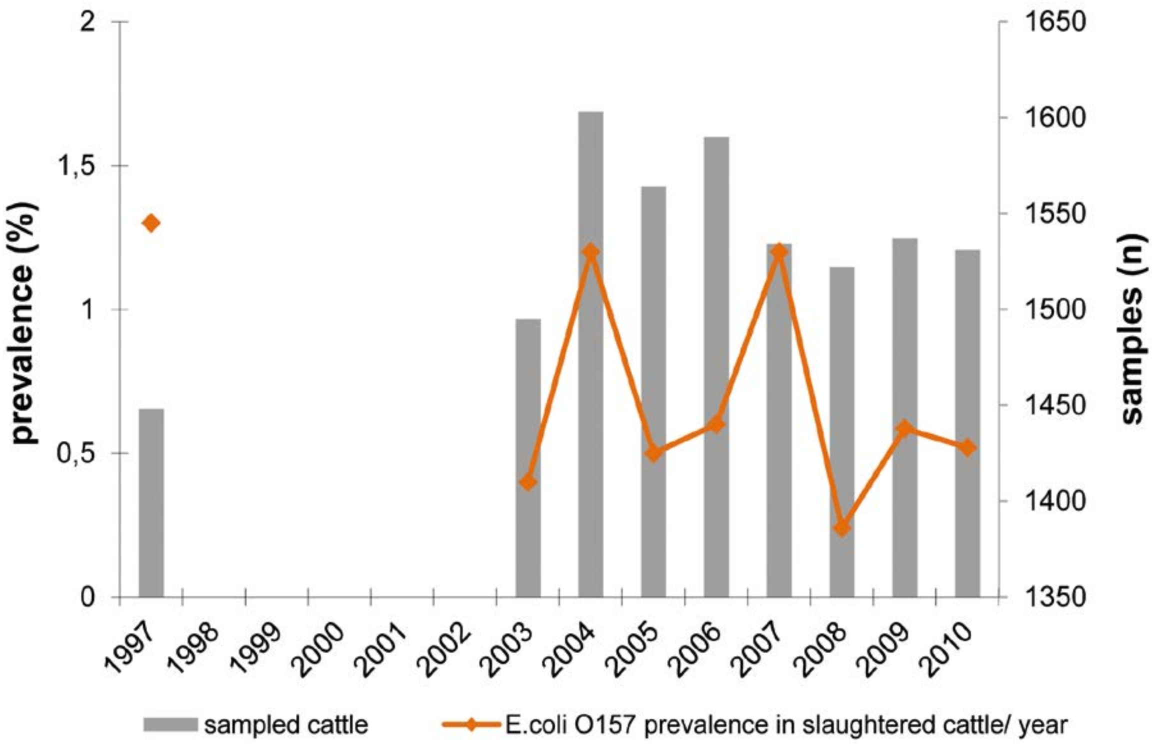


Figure: *Results of the VTEC O157 bacteria monitoring in cattle at slaughter on a yearly level in 1997, 2003–2010 (Evira)*

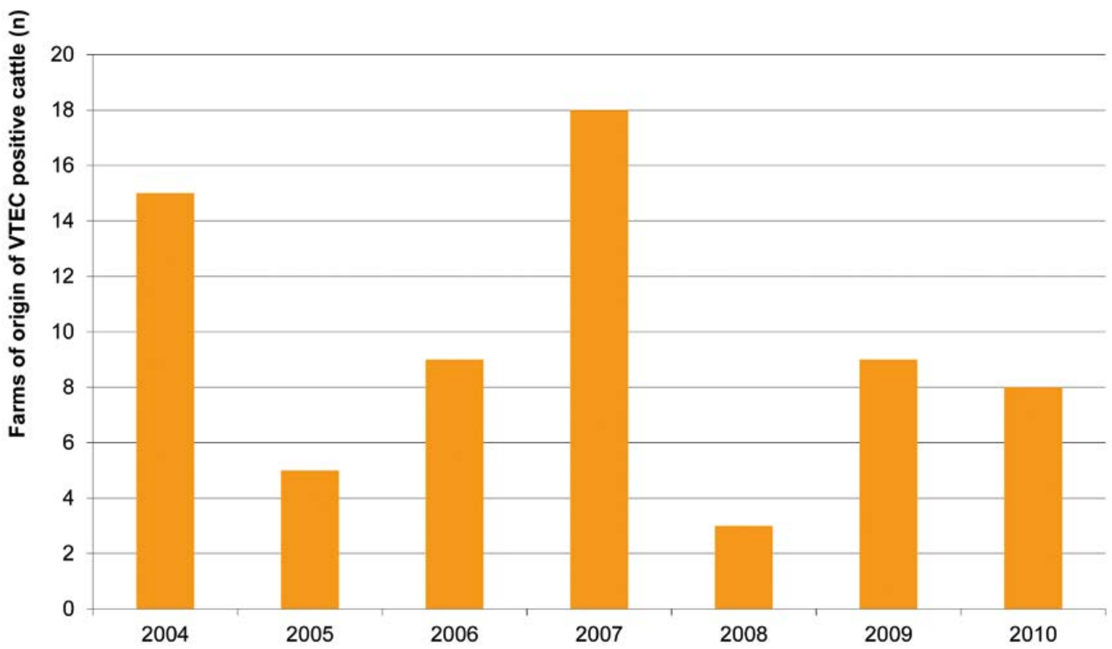


Figure: *Annual number of cattle farms where VTEC bacteria have been found within the scope of the EHEC control programme 2004–2010 (Evira).*

5.5. Rabbit fever (tularemia)

Rabbit fever, or tularemia, is an infectious disease caused by the bacterium *Francisella tularensis*. In the Nordic countries, small rodents and hares are regarded as the reservoir of *F. tularensis*. The bacterium can remain viable for months in the soil, water and animal carcasses. As the bacterium is usually transmitted through blood-sucking insects, tularemia cases occur mainly in July–October when the number of insects is at its highest. The number of cases is also affected by the viable populations of hares and moles.

5.5.1. Tularemia in humans

Tularemia infection is mainly spread through insect bites. Infection can also be transmitted directly from a sick or dead animal, e.g. as wound infection or through airborne transmission from contaminated environment.

The occurrence of tularemia varies considerably from year to year. The majority of cases are found between August and September. There were extensive tularemia epidemics in 2000, 2003, 2006–2007 and 2009, and previously in 1995–1996.

5.5.2. Tularemia in animals

In mammals, *Francisella tularensis* causes a disease accompanied with fever, and this disease is called tularemia. The bacterium has been found in over 200 different animal species. These animals also include fish, reptile, birds and insects. Our domestic animals are not particularly susceptible

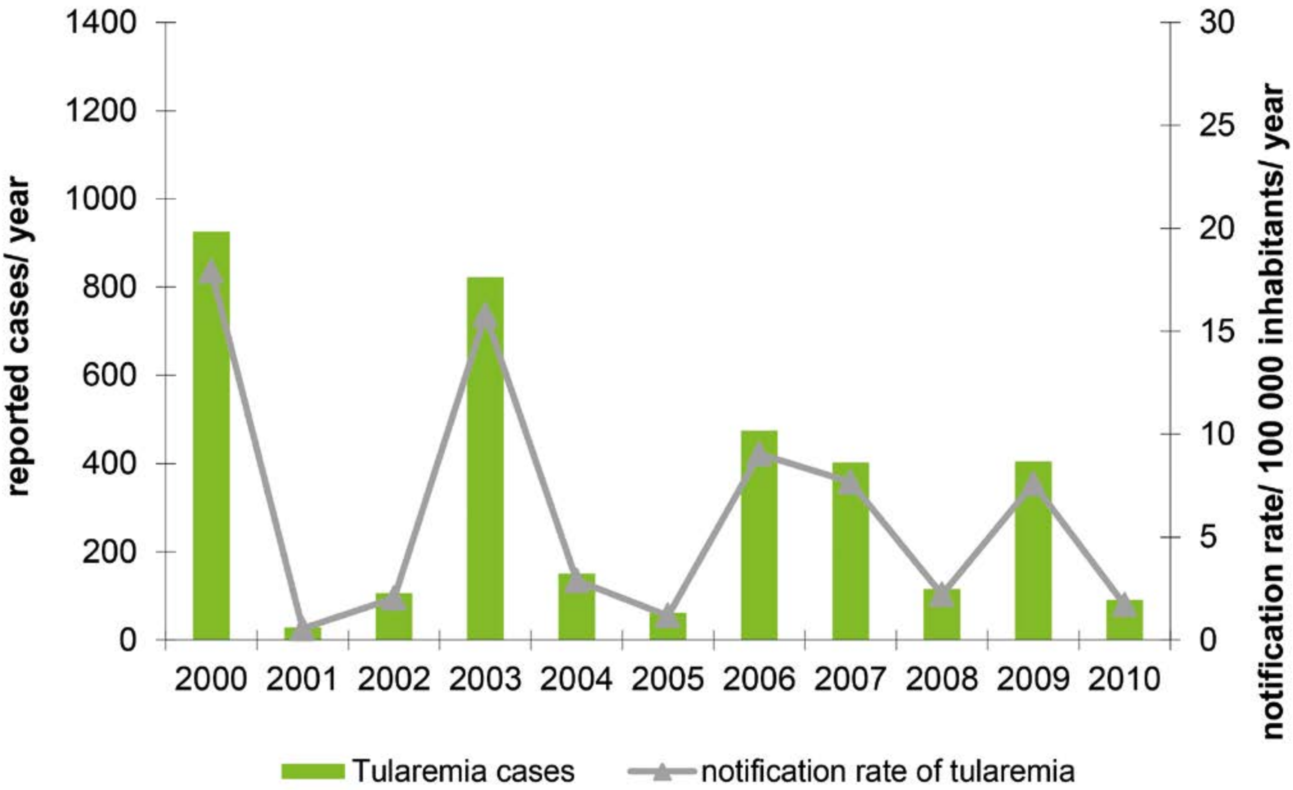


***Figure:** Reported cases of tularemia in people in 2000–2010 (Source: National Infectious Diseases Register, THL)* to the pathogen and therefore, e.g. the chance of a hound developing the disease is very small.

However, cats are more susceptible to the bacteria, and some infections have been found in them. In Finland, tularemia as a clinical disease is found most commonly in lagomorphs, in which infection will inevitably lead to death. It has been discovered that wild small rodents can be carriers of the bacterium.

The bacterium *F. tularensis* is usually transmitted from one animal to another through blood-sucking insects. Therefore, tularemia cases occur between July and October when contact between mosquitoes, lagomorphs and moles is at its highest. An animal can also be infected directly from a sick or dead animal, e.g. as a wound infection or through the mucous membrane. Infection may also take place through the respiratory tract or mouth through a contaminated environment, such as air, water, soil or plant-based material.

At Evira, the possibility of tularemia is always taken into account when examining wild animals that are found dead or put down due to illness. Dozens of brown hares and blue hares, as well as individual beavers, muskrats and moles are examined each year. However, in Finland animals are examined for tularemia only randomly, and therefore there is no detailed information about the possible distribution of the disease in Finland.

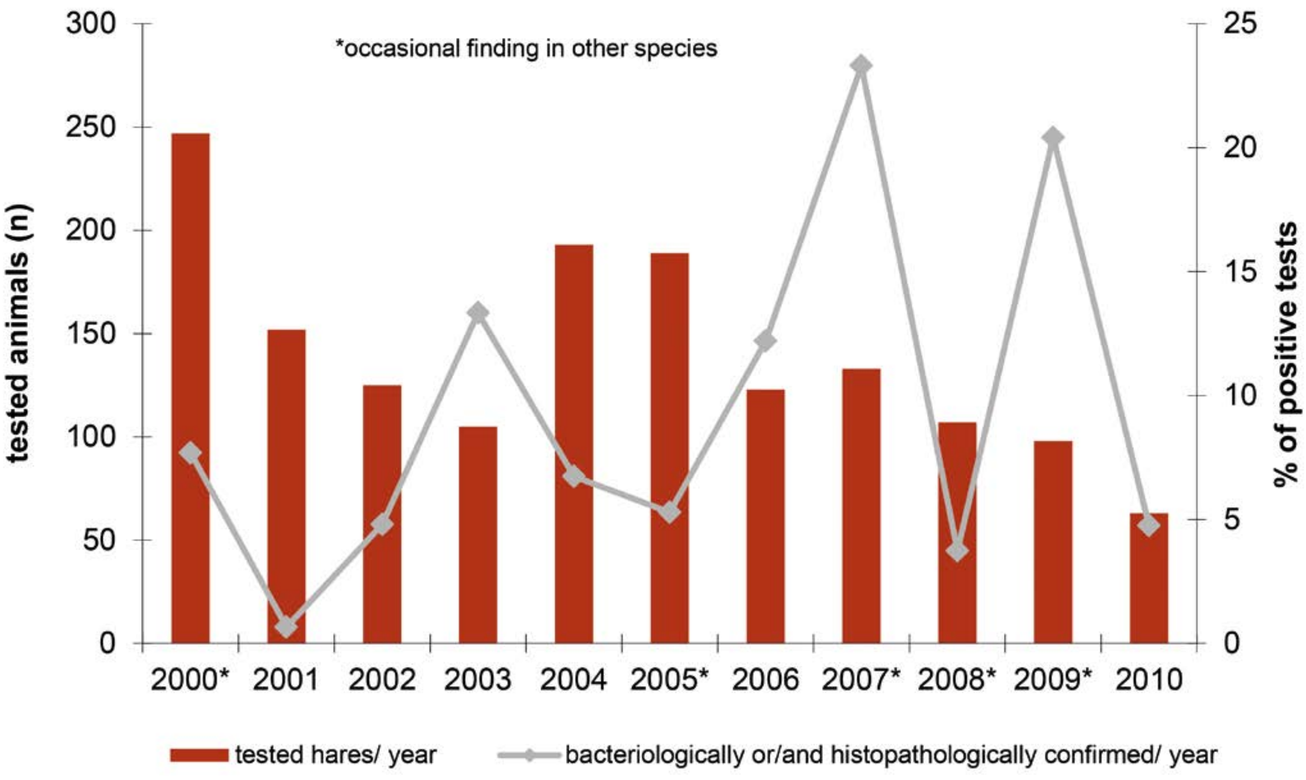


Figure: *Tularemia tests on wild animals in 2000–2010 (Source: Evira)*

5.6. Campylobacteriosis

Campylobacteriosis is an infection caused by a bacterium of the *Campylobacter* genus. Campylobacters are very common in both animals and humans throughout the world. Of about twenty known *Campylobacter* species, only several cause disease in humans. Campylobacters are often found in lake and river waters and in other surface waters that are contaminated by both wild animals and human activity. Campylobacters may stay viable in cool waters for several weeks or even months.

5.6.1. Campylobacteriosis in humans

In humans, the most significant *Campylobacter* species causing intestinal symptoms is *Campylobacter jejuni*, but similar symptoms can also be caused by, e.g. *C. coli*, *C. lari* and *C. fetus*. Of the *Campylobacter* species, *C. jejuni* and *C. coli* are the most common pathogens causing disease in Finland. Infection is usually food or waterborne, but may also arise through direct animal contact. Consumption of unpasteurised milk has caused infections also in Finland. Factors resulting in food-borne campylobacteriosis include contaminated raw foodstuff, cross contamination, insufficient heating and an food handler carrying the bacterium.

In the 2000s, over 3,000-4,000 cases of campylobacteriosis were reported to the National Infectious Diseases Register each year (incidence 61–78 cases per 100,000 population). The highest number of cases was reported in July–August. The incidence rate has been the highest among young adults. Information about travelling abroad before onset of illness has been collected in the National Infectious Diseases Register since 2004, but the information has not been comprehensive. The majority of infections have probably been acquired abroad; however, the proportion of infections acquired in Finland in the summer period is considerable.

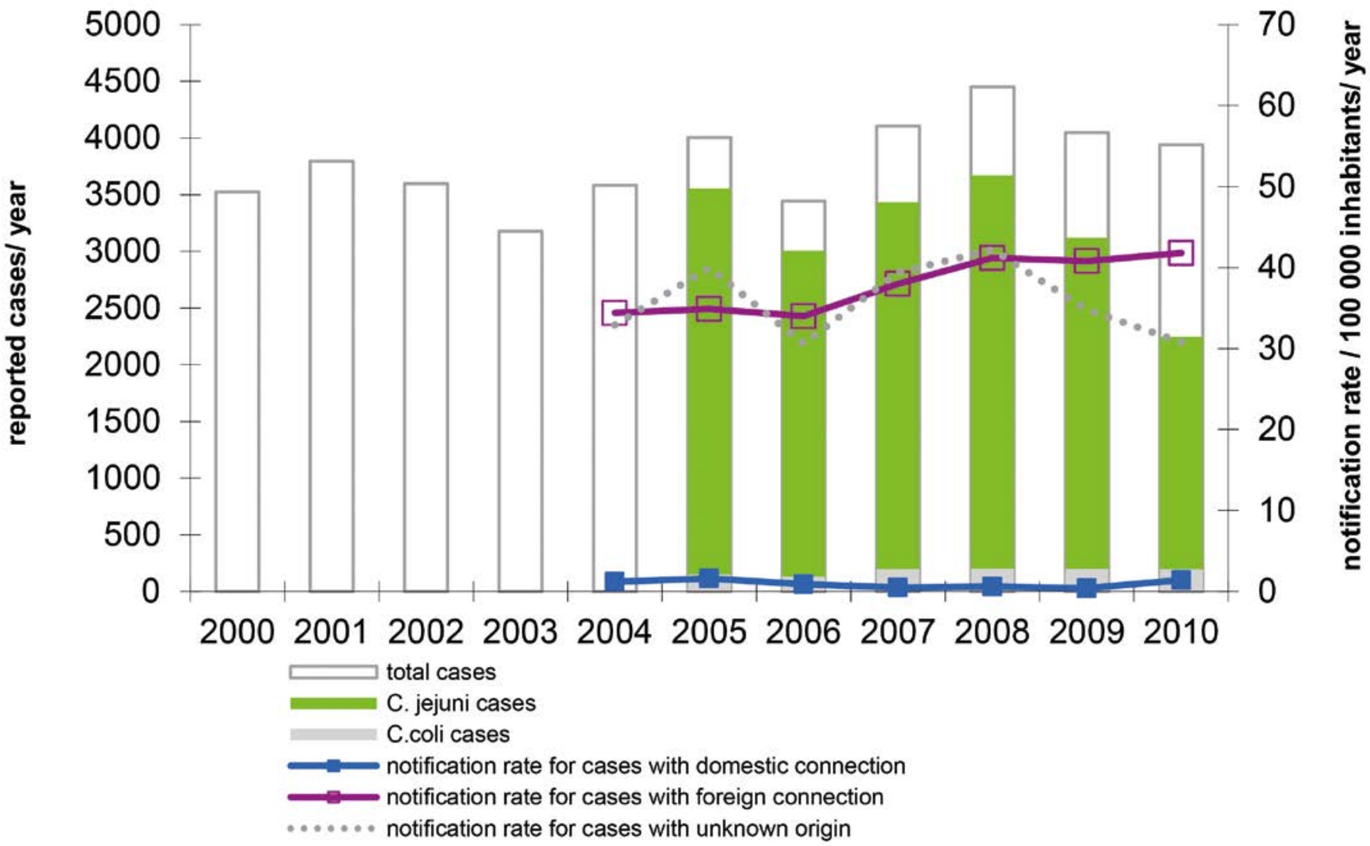


Figure: *Reported cases of campylobacteriosis in people in 2000–2010 (Source: National Infectious Diseases Register, THL)*

Between 2005 and 2010, there were 1-2 reported food-borne outbreaks caused by Campylobacters each year.

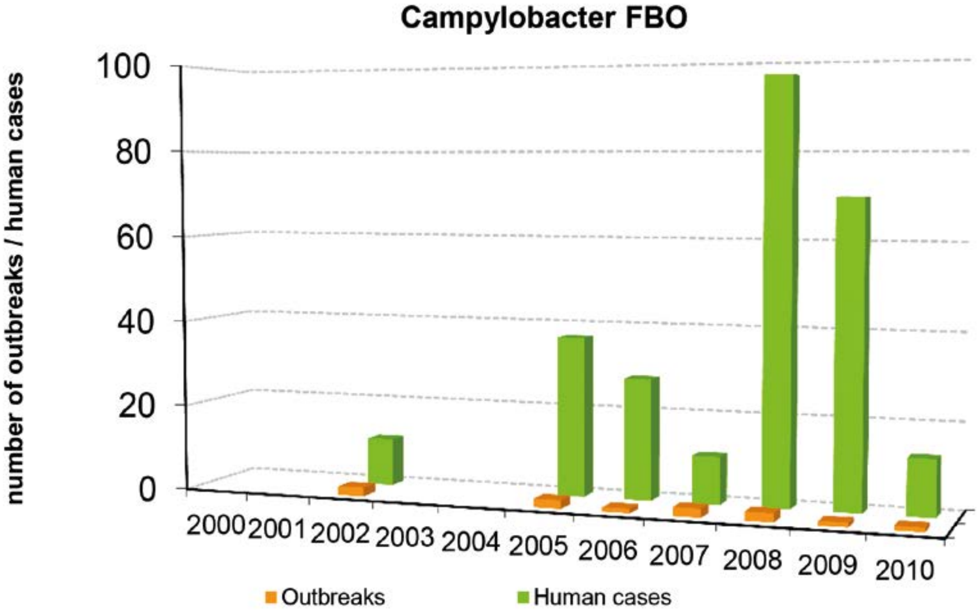


Figure: *Reported food-bome outbreaks caused by Campylobacter sp. in 2000–2010 (Source: Food-borne Outbreak Register, Evira)*

5.6.2. Campylobacter in food

Campylobacters have been detected in poultry meat, unpasteurised milk and vegetables and berries that are eaten raw. In Finland, contaminated drinking water has caused several extensive outbreaks.

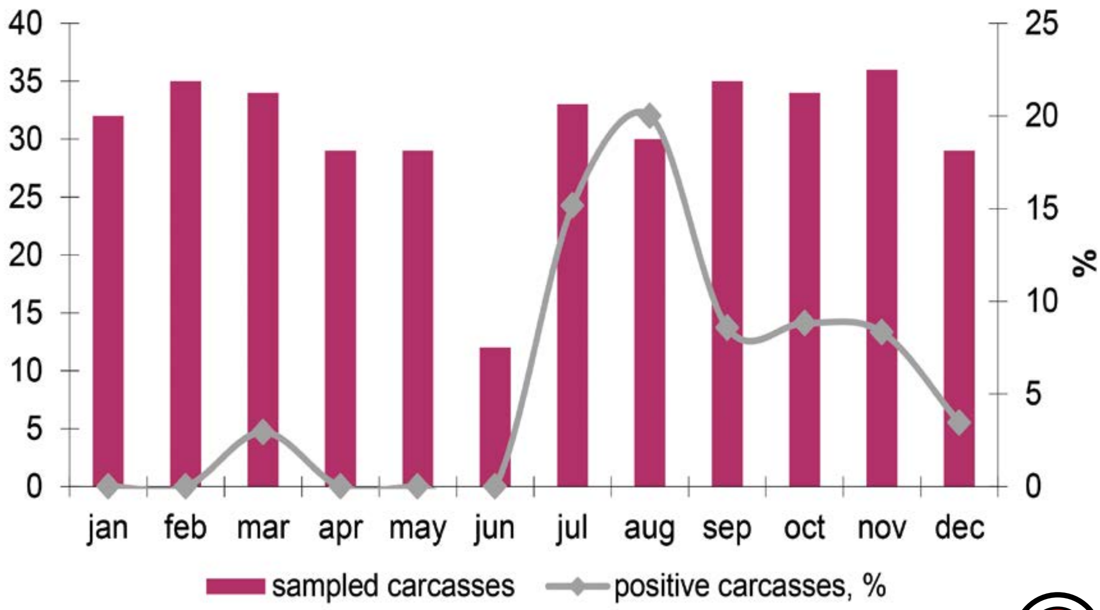
Campylobacters are easily destroyed when heated. During food preparation, however, the bacteria may spread from uncooked, usually chicken meat, e.g. via cooking utensils to other food or foodstuffs that are not heated, such as salads.

Although campylobacter colonisation in the intestines of cattle and pigs is fairly common, the bacteria is usually not detected in meat, since they are killed rapidly due to drying of the surface of the carcasses during the slaughter process. Campylobacters are not able to multiply outside the intestines, but they can survive in poultry meat under broken skin or feather sheaths where they are protected from drying and the effect of oxygen. The occurrence of campylobacters in poultry carcasses, peaks during late summer and early autumn. However, the number of campylobacters in poultry meat is usually small.

Campylobacters may end up in milk during milking as a result of faecal contamination, but pasteurisation destroys them effectively. Fresh vegetables and berries may be contaminated with campylobacters through wild animals or contaminated irrigation water. *C. jejuni* has been shown to survive on strawberries sufficiently long to pose a risk of infection.

In Finland, most of the studies related to campylobacters in food have focused on poultry meat as it is a common source of campylobacteriosis. A smaller number of campylobacter bacteria have been found in other high-risk foods in Finland.

Figure: *A study of the prevalence of campylobacters in slaughtered broiler carcasses in Finland in 2008 (Source: EU-wide baseline study, Evira)*



	Year	Number of samples analysed	Campylobacter (%)	*C. Jejuni* (%)	*C. Coli* (%)
Meat and meat products					
▪ Poultry					
chicken carcass'	2008	369	5.9	5.9	0
fresh chicken meat*	2004	104	-	19.2	0
fresh turkey meat*	2004	26	-	15	4
poultry meat***	2003	124 / 62 batches	12.9 / 19.2		
raw poultry preparation***	2003	30 / 15 batches	3.3 / 6.7		
chicken meat*	August–September 2001	101	22,7.		
chicken meat*	1995 - 2000	100 - 159	4.1 - 13		
▪ Beef					
beef carcass**	2003	948	3.5	3.1	0.2
Dairy products					
▪ Cheeses					
raw milk, soft/hard***	2004	56 / 28 batches	0		
raw milk, soft/hard**	2004	94 / 20 batches	0		
Berries and vegetables					
▪ Strawberries**	2004	142 (29 farms)	0.7	0.7	0

'EU-wide baseline study; *from Finnish retail trade; **Finnish origin; *** from intercommunity market trade

Table: *Campylobacters in some foods studied in Finland (Source: Evira)*

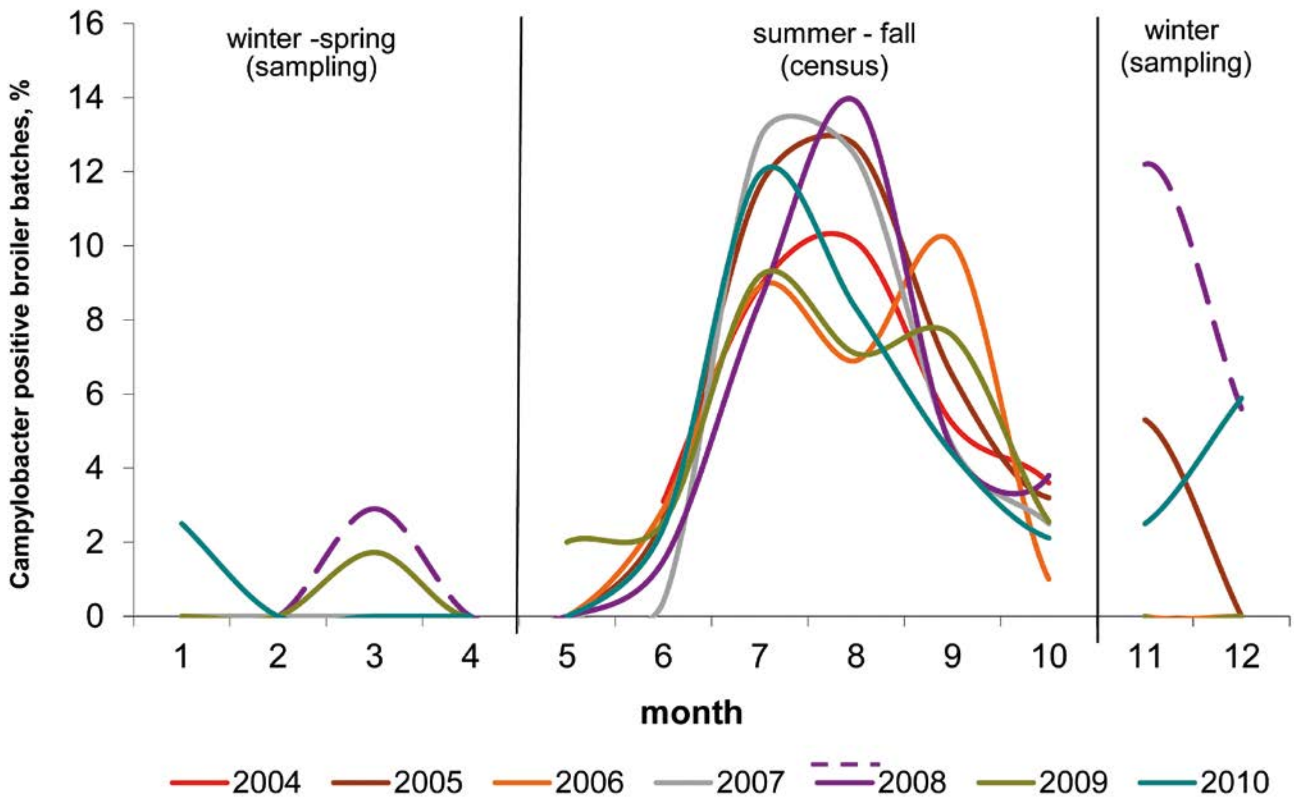


***Figure:** The monitoring results of campylobacters in broiler batches since 2004 (in 2008, random sampling in the annual programme deviated according to the EU-wide baseline study) (Source: Evira)*

5.6.3. Campylobacters in animals

Production animals

Campylobacters are common in the intestines of birds and mammals. Of the *Campylobacter* species in animals, *C. jejuni* and *C. coli* are the most significant pathogens in humans. The most common species in poultry and cattle is *C. jejuni* and in pigs *C. coli*. Campylobacters that cause disease in humans do not usually cause disease in animals.

A study, in 2003, indicated that an average of 31% of slaughter cattle were carriers of campylobacters. *C. jejuni* was isolated in 20% of the tested animals. In a recent study, campylobacters were not detected in the milk tank samples collected from several dairy farms. *C. coli* was detected in 56% of pig faecal samples collected at slaughter in 2004.

Poultry is generally regarded as the most important reservoir of *C. jejuni* that causes disease in humans. The bacterium spreads into the broiler rearing houses from the environment. In the broiler intestines, the conditions are optimal for the growth of campylobacters. In large broiler flocks, the bacterium spreads effectively from one bird to the next, and in the slaughterhouse the carcasses are easily contaminated.

The occurrence of campylobacters in Finnish broiler poultry has been monitored systematically since 2004 as part of the in-house control programme of the slaughterhouses. The programme requires that every broiler slaughter batch is tested for campylobacters from the beginning of May until the end of October and random samples to be taken according to a separate plan between November and May. Within the scope of the programme, campylobacters have been detected in an average of 6.5% of broiler batches slaughtered between June and October. The prevalence in broiler slaughter batches has been at its highest in July–August, an average of 10.5%. In November–December and in January–May, campylobacters have been rarely detected in the tested batches. During the monitoring, the annual level in the prevalence of campylobacters in broiler slaughter batches has remained the same.

C. jejuni is the most common *Campylobacter* sp. isolated from broilers (an average of 92.1% of isolates each year) and *C. coli* to a lesser extent (an average of 7.2% of isolates each year). Other species of Campylobacter have been detected occasionally.

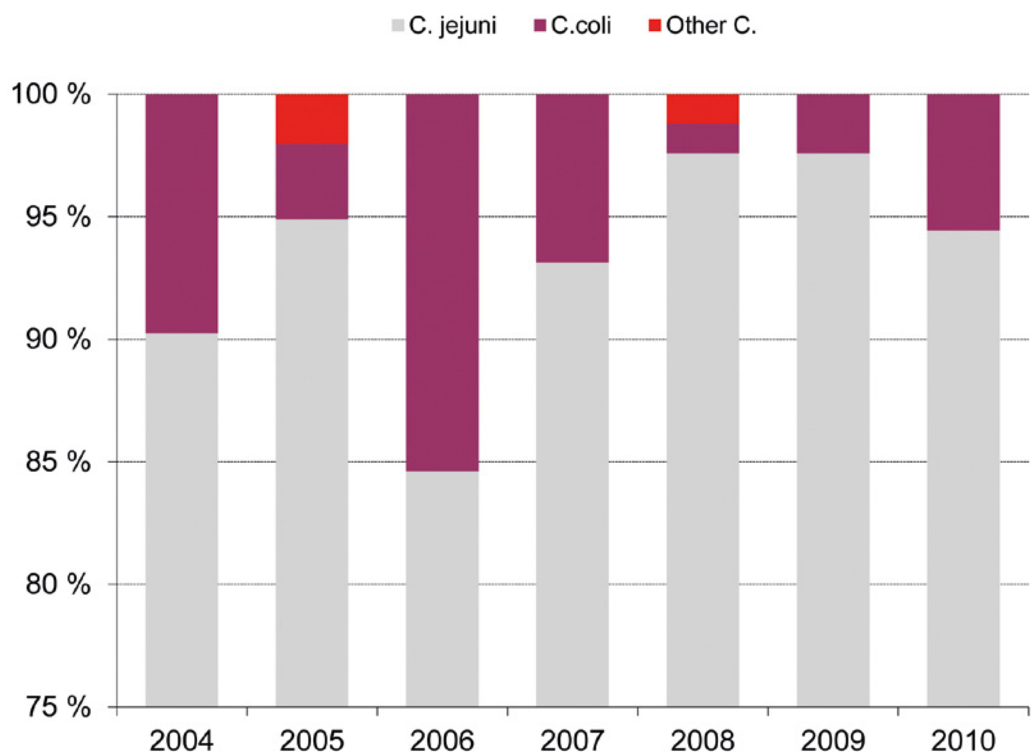


***Figure:** The proportion of different Campylobacter species detected in the monitoring of campylobacters in slaughter broilers in 2004–2010 (Source: Evira)*

Other animals

In fur farms, *C. jejuni* is often found associated to diarrhoea of young animals. Sporadic cases and outbreaks of campylobacteriosis have been detected in dogs and cats.

5.6.4. Significance of campylobacters in Finland

Since 1998, campylobacters have been the most common cause of intestinal infections in humans. For the majority of the cases the origin of infection is probably abroad. It has been estimated that almost one in three campylobacter infections acquired in Finland in the summer period are associated with poultry and one in five directly or indirectly with cattle. However, about half of the campylobacter infections contracted in Finland probably come from other sources.

Although campylobacters are common in Finnish production animals, the observed prevalence is, lower than in most other countries. The proportion of broiler slaughter batches contaminated with campylobacters peaks in late summer, but even then it is relatively low. The routes of infection between animals and humans, or those common to both of them, are not sufficiently known to be able to effectively prevent campylobacter infections.

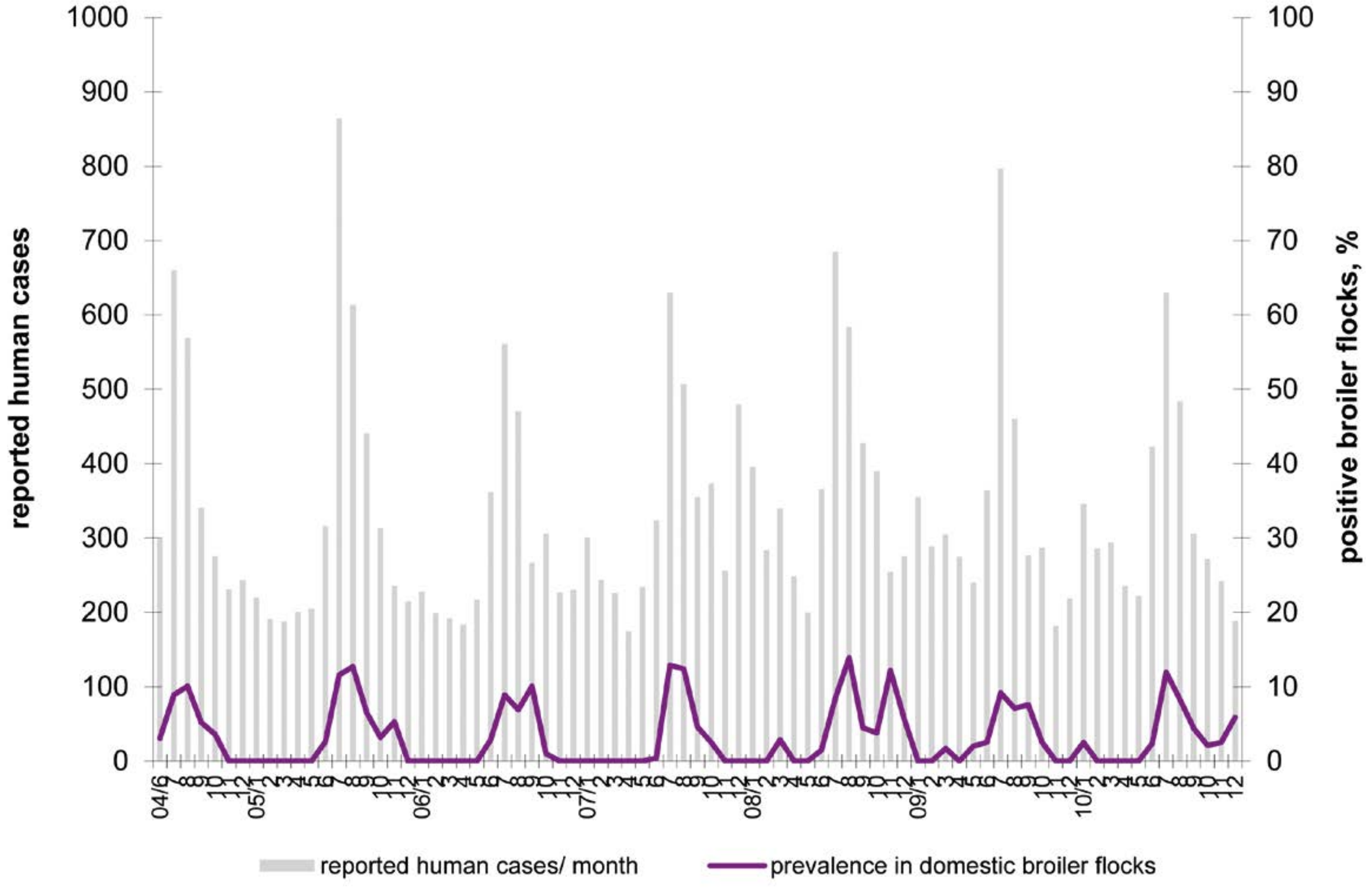


Figure: *Cases of campylobacteriosis in people reported monthly to the National Infectious Diseases Register, and monthly results of the monitoring of the prevalence of campylobacters in broiler slaughter batches between June 2004 and December 2010 (Source: Evira/THL)*

Case report – examples of food-borne and water-borne outbreaks caused by Campylobacter jejuni

In 2002, several cases of campylobacteriosis related to an outbreak were reported in July–August in three municipalities. Six persons had severe symptoms and three of them were hospitalised. Based on a questionnaire study, the only factor in common among the patients was eating garden strawberries directly from the field prior to falling ill. All patients had eaten berries grown in different strawberry fields. Each municipality had its own groundwater pumping plant and the water distributed by them as a possible source of infection was ruled out in the investigation. There were a lot of wild birds harming the strawberry fields, and these may have spread the infection. No clear evidence of food-borne transmission was found, but the results of the investigation suggested that the infection was transmitted by strawberries.

C. jejuni caused two small water-borne outbreaks in 2004, in which a total of nine people fell ill. In both cases, the cause of the outbreak was contamination of well water with surface water. Despite increased turbitity of the well water, it had been used as household water. In one of the outbreaks, *C. jejuni* was found in the patients and in the well water, and in the other outbreak, *C. jejuni* of the same serotype was found in the patient and in the water of a nearby brook.

Two of the five outbreaks spread through household water registered in 2005, were caused by *C. jejuni*. In the most extensive reported outbreak, the suspicion of an outbreak arose in late October when an unusual number of patients sought for medical attention at the health centre. *C. jejuni* was isolated in three persons. Based on information reported to the health centre, about 600 people in total contracted gastroenteritis in the municipality, between October to November. A questionnaire study did not reveal any common factor explaining the cause of the disease, such as the same place of dining or the same food. Suspicion of a tap water-borne outbreak was raised. Advice was given to boil tap water used for drinking, and chlorination of tap water was started. A sample collected from the water tower revealed a small number of intestinal enterococci, but no campylobacters were detected. In the water tower, two squirrels were found on the surface of the water, and these were sent to be examined. When the water tower was emptied for cleaning and disinfection, several dead squirrels were found on the bottom of the water tower. *C. jejuni* was isolated from the squirrels. The campylobacter isolates from the patients and the squirrels represented the same serotype and identical genotypes. The water tower was repaired so that squirrels or other animals could no longer enter the tower.

In 2007, Campylobacteria was reported to have caused two minor food-borne outbreaks. In July, seven adults contracted campylobacteriosis whose suspected source was salad from a kitchen garden, served at a private party. In July–August, four people were infected with *C. jejuni*. Three of those who fell ill had used unpasteurised milk from the same dairy farm.

The water-borne epidemic in the town of Nokia in late 2007 was exceptional in terms of its extent. The spectrum of pathogens was wide because about 400,000 litres of purified waste water entered the tap water network over the course of two days. Samples collected from patients and tap water were found to have several pathogens: *C. jejuni*, norovirus (genotypes GI and GII), *Salmonella* Enteritidis, *Clostridium difficile* and rotavirus, as well as *Giardia*. *Shigella boydii* was found in the patients. In early 2008, the National Public Health Institute, the Pirkanmaa Hospital District, the Town of Nokia, and University of Tampere carried out an extensive questionnaire study where a questionnaire was sent to a total of 3,000 people in Nokia, as well as in Kangasala which was selected as the reference municipality. Based on the study, the key pathogens were campylobacter, norovirus and giardia.

In the city of Tampere in September 2008, two persons had started presenting symptoms typical of a campylobacteriosis (diarrhoea, stomach cramps and fever) about three days after dining at a restaurant. Campylobacter bacteria were found in the stool samples of both of them. The local authorities carried out an inspection at the restaurant and detected several deficiencies, for example, in the general hygiene levels. The *C. jejuni* bacteria were also found in frozen duck breast taken as a sample during the inspection visit.

5.7. Listeriosis

Listeriosis is an infectious disease caused by the bacterium *Listeria monocytogenes. L. monocytogenes* (more commonly listeria) is common in the environment and it withstands exceptionally demanding environmental conditions. Listeria is common in the soil, in plants and in community and agricultural waste waters.

L. monocytogenes have several strain types (geno- and serotypes). Determining the listeria strain type is essential, e.g. when ascertaining the source of infection.

5.7.1. Listeriosis in humans

Listeria infection is usually acquired through contaminated food. Sources of infection can include products that are refrigerated for a long time, such as vacuum-packed fish products. Listeria can also be caught directly from a sick animal, e.g. by an animal caretaker.

In the 2000s, the annual number of reported listeria infections in Finland has varied between 20 and 45. However, in 2010 there were 71 cases reported. Listeriosis cases seem to have become slightly more common since the early 2000s. Only 0–2 pregnancy-related cases have been identified per year.

5.7.2. Listeria in food

L. monocytogenes may be present in vegetables, as well as in milk, meat and fish products. In terms of food production and storage of food, it is particularly problematic that listeria is also able to reproduce in low temperatures as in a refrigerator. Listeria bacteria are destroyed in pasteurisation temperatures (72°C). Although food is regarded as the most significant source of listeria infection, it is usually difficult to trace a connection to a certain food because the incubation period of listeriosis may be long.

Of the high-risk foods, especially vacuum-packed, cold-smoked and gravad (salt-cured) fish products have been studied in Finland because they have contained Listeria and because mutually identical genotypes of *L. monocytogenes* bacteria have repeatedly been found in them and in

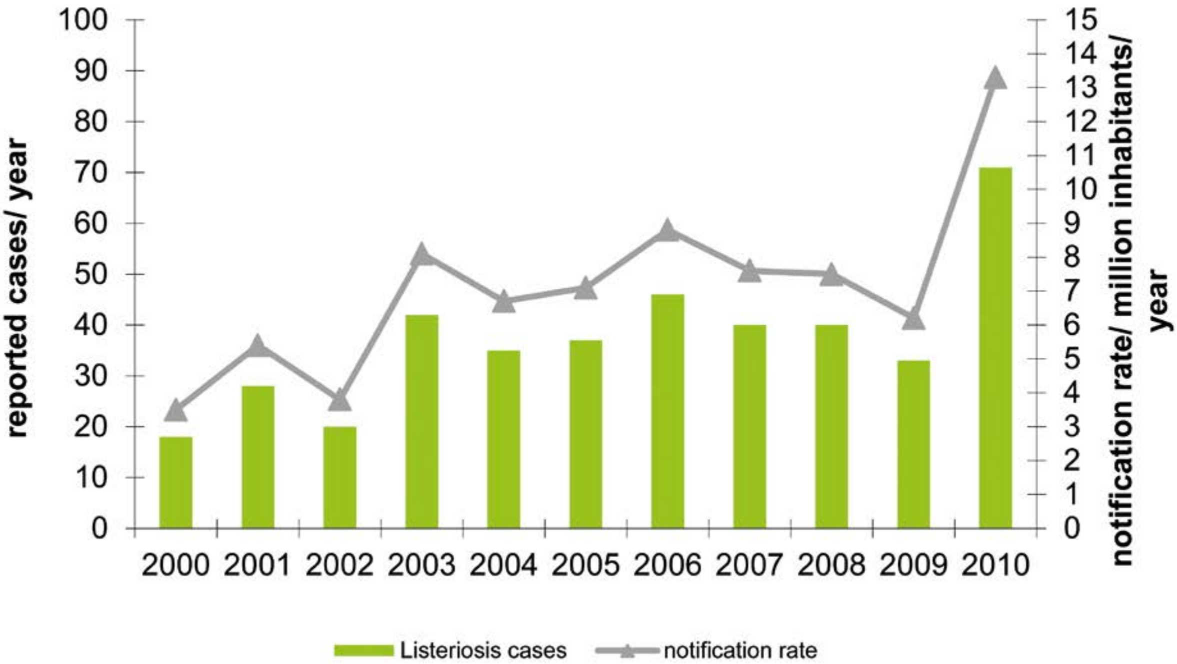


Figure: *Listeriosis cases reported to the National Infectious Diseases Register in 2000–2010 (Source: THL)*

	Year	Number of samples analysed	Listeria (%)	Content >100 pmy/g
Fishery products				
▪ **Cold-smoked fish products**				
vacuum-packed	2008–9	198	29.8	0.5%
vacuum-packed	2004	223	20	3.2%
service sales	2004	54	7.4	
vacuum-packed	2001	356	13	3.7%
vacuum-packed	2000	232	4.3	0.0%
▪ **Salt-cured fish products**				
vacuum-packed	2008–9	256	32	2.3%
vacuum-packed	2004	204	14	1.4%
service sales	2004	81	16	
vacuum-packed	2000	82	6.1	0.0%
▪ **Roe**	2004	29	0	
Dairy products				
▪ **Cheeses**				
soft, pasteurised milk*	2004	132 / 66 batches	0/0	
soft/semi-hard, raw milk**	2004	60 / 30 batches	0/0	
soft/semi-hard, raw milk***	2004	90 / 18 batches	5.6 / 11	5.6 / 11.0%
soft*	1996–8	49	0	
fresh	1996–8	144	0	
Berries and vegetables				
▪ **Strawberries**	2004	142 (29 farms)	1.4	0.0 %
▪ **Carrots**				
storage carrots	2005–6	127 (18 farms)	0	
retail carrots	2005–6	96	1	0.0%
▪ **Other**				
frozen vegetables**	1998–9	313	20	-
frozen berries**	1998–9	311	1.3	-

*both Finnish and foreign origin; **foreign origin, 2 batches of Finnish origin; *** Finnish origin, sampling from the places of preparation

***Table:** Listeria monocytogenes in some foods studied in Finland (Source: Evira / EVI)*

Case report – listeriosis from home-prepared mushroom salad

Listeria outbreak was reported in July 2006 when 11 out of 30 (36%) guests at a birthday party contracted listeriosis after eating some mushroom salad prepared with mushrooms salted in a private household. *L. monocytogenes* was isolated from samples of the salted mushrooms and the mushroom salad that had been offered to the guests. In 2006, flame-cooked salmon was traced as the source of infection of two invasive cases of listeriosis. The fish products had come from different producers.

listeriosis patients. Listeria has not been found in other high-risk foods to any significant extent in Finland.

Vacuum-packed fishery products

Vacuum-packed, cold-smoked and gravad fish products have been studied repeatedly with sampling carried out about every four years. The fish products in this product group have repeatedly been proven to have *L. monocytogenes* bacteria. However, the number of bacteria in the findings has mainly been low: for example, in the study carried out in 2008–2009, only 0.5% of the Listeria findings exceeded the so-called microbial criteria limit value of 100 cfu/g set for foodstuffs.

5.7.3. Listeriosis in animals

Listeriosis, i.e. infections caused by *L. monocytogenes* bacteria, is found very rarely in animals. All warm-blooded animals can contract listeriosis. The source of infection in ruminants is usually silage of poor quality. Infection does not usually present any symptoms, but sometimes listeria causes e.g. abortions, eye infections, encephalitis and meningitis. Abortions can occur in all mammals, most typically in sheep, goats and cattle. Listeria in the brain is most common among adult ruminants, occasionally it is also found in other animal species. For the young of most animal species, listeria can result in general infection. Listeriosis is also found in wild animals, especially in hares.

Of the animals sent to Evira for examination to establish the cause of death, Listeria infections have occasionally been found in cattle and sheep and in wild animals. For example, in 2010, six sheep and one goat were diagnosed with listeriosis.

5.7.4. Significance of Listeria in Finland

Listeriosis was the fourth most common food-borne bacterial infection in Finland in the 2000s. The majority of the infections were contracted in Finland. In Finland, especially vacuum-packed, cold-smoked and salt-cured fish products have been found to be high-risk foods. Domestic animals are not a significant source of infection for humans.

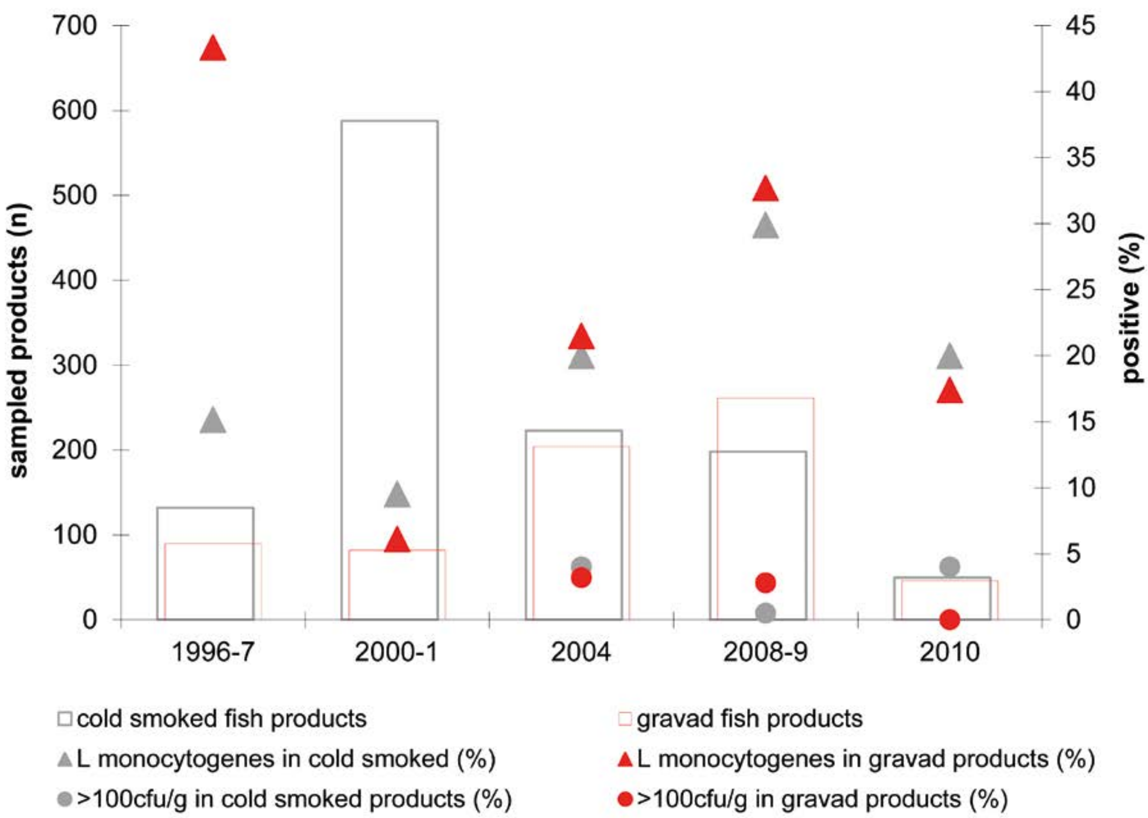


Figure: *The national occurrence studies of L. monocytogenes bacteria on fish products (exceedings of >100 pmy/g were not studied before 2004) (Source: Evira / EVI)*

5.8. Bovine tuberculosis

Bovine tuberculosis is caused by the bacterium *Mycobacterium bovis*, which, in addition to cattle, can also infect many other animal species, such as dogs, cats, pigs, goats and badgers. In addition to cattle, deer are also very susceptible to infection. *Mycobacterium bovis* and *Mycobacterium tuberculosis* are different variations of the same bacterial strains – their genomes are almost identical. *M. tuberculosis* is the most typical cause of tuberculosis in humans, but *M. bovis* can also cause tuberculosis in humans.

5.8.1. Bovine tuberculosis in humans

In previous decades, especially milk was a significant source of food-borne infection in humans. Due to the strict tuberculosis control of cattle, *M. bovis* infection in humans in Finland is very uncommon. These days, humans are usually infected through the respiratory tract, but in Finland even that is extremely unlikely. In Finland, there were no findings of the *M. bovis* infections in humans in the 2000s. Moreover, no infection has been reported to the National Infectious Diseases Register during its existence since 1995.

5.8.2. Mycobacterium bovis in food

Previously, *M. bovis* infection from unpasteurised milk was common, but along with pasteurisation of milk the route of infection has practically disappeared. In practice, the most important method to prevent tuberculosis in Finland is the inspection of the carcass and organs of every slaughtered animal, carried out during meat inspections. Further investigations due to suspicion of *M. bovis* infection have been launched after meat inspection on a few slaughtered animals each year. All with negative results.

5.8.3. Bovine tuberculosis in animals

Bovine tuberculosis is a chronic disease whose symptoms and duration depend on, e.g. which organ is subject to tuberculotic changes. Infection usually takes place through the respiratory tract or the digestive system. In addition to cattle, *M. bovis* can also spread to deer and pets.

Prevention of bovine tuberculosis in Finland was launched with voluntary testing in the early 20th century. Prevention measures were developed, and between 1946 and 1966, all milk-producing

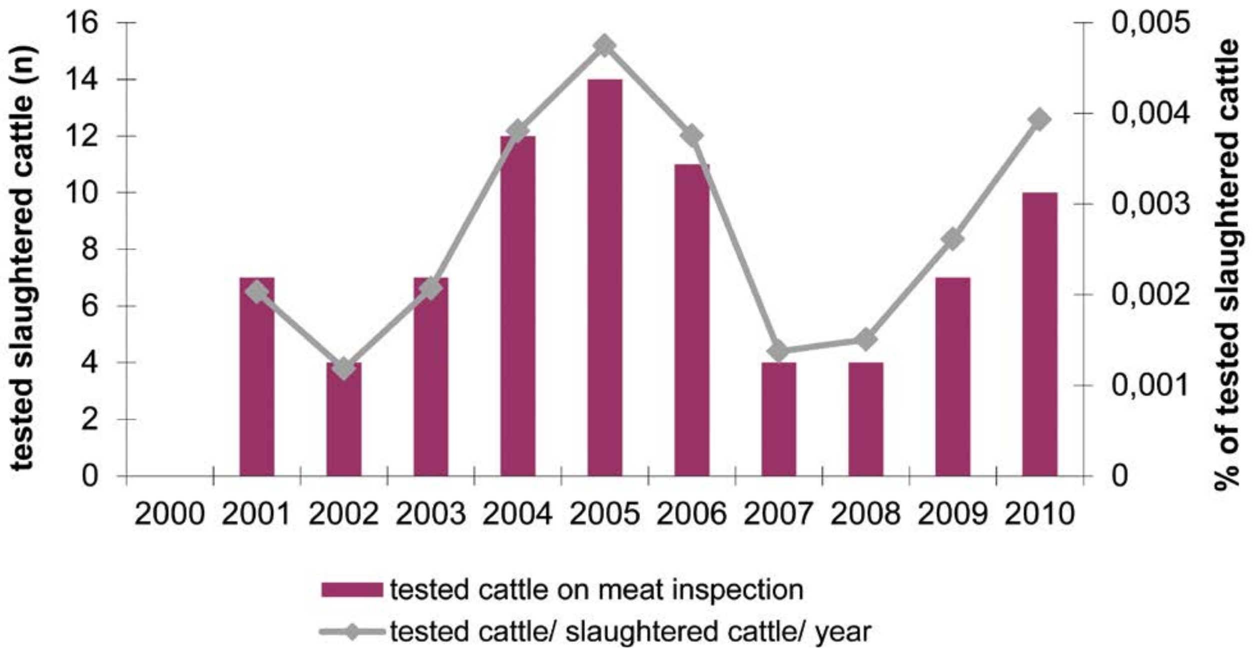
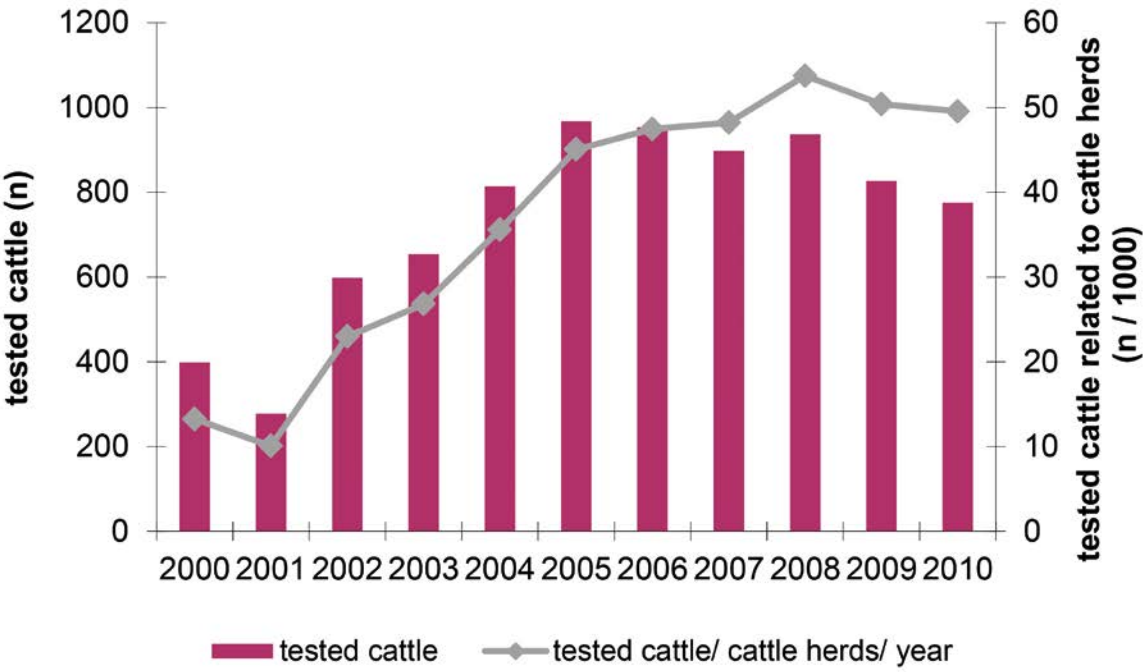


Figure: *Slaughtered cattle examined for M. bovis after meat inspection in 2001–2010 (Source: Evira)* cattle were examined for tuberculosis every five years in accordance with the milk inspection regulations. Routine inspections were abandoned after 1966 after the number of cattle with tuberculosis had reduced significantly. The last outbreak of the disease in Finland was limited to one cattle herd in 1982.

Bovine tuberculosis is currently investigated in connection with the health control programme for artificial insemination bulls and the import and export of animals. Occurrence of bovine tuberculosis in deer farms has been monitored within the scope of the health control programme of deer farms since 1997. No cases has been diagnosed in deer.

5.8.4. Significance of bovine tuberculosis in Finland

Mycobacterium bovis bacteria causing disease in humans do not occur in Finland. Finland has officially been declared free of bovine tuberculosis by the decision of the European Commission.



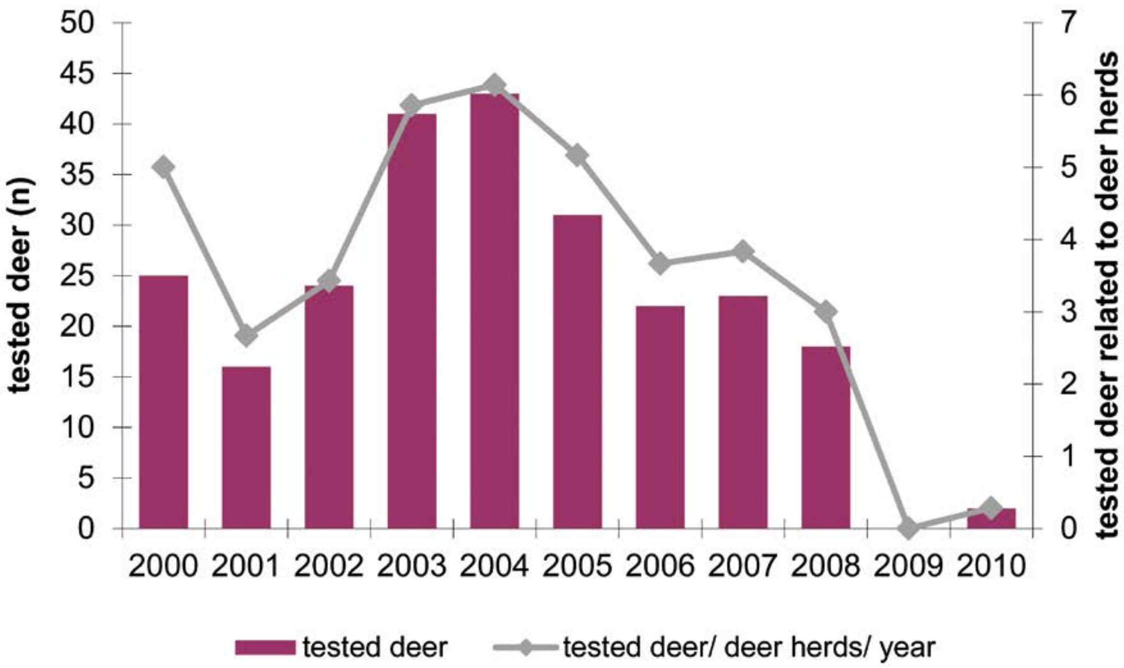


Figure a-b: *Tuberculosis examinations of cattle (a), farmed deer (b) in 2000-2010 (Source: Programmes for preventing and monitoring animal diseases, Evira; the Farm Register (MATILDA), Tike)*

5.9. Anthrax

Anthrax is a disease caused by the spore-forming bacterium *Bacillus anthracis*. The spores formed by the bacterium can survive in the soil for decades.

5.9.1. Anthrax in humans

Anthrax infections in humans are very rare. Anthrax can spread to humans from infected animals, from animal products containing bacterial spores (e.g. skins), or from contaminated soil through the respiratory tract, the digestive system or skin wound. In Finland, no cases of anthrax have been diagnosed in decades. No infection has been reported to the National Infectious Diseases Register during its existence since 1995.

5.9.2. Anthrax in animals

Anthrax is mainly known as a disease of cattle, sheep, goats and other herbivores. Infection can take place through the intestines, damaged skin or the respiratory tract (spore dust). Most commonly, infection takes place through the intestines with contaminated feed or water being the source of infection. Anthrax bacteria form spores that survive in the soil for decades and can therefore cause epidemics in the same areas even after decades.

Since 1940, there have been 283 cases of anthrax in 150 different localities in Finland. In the 1940s and the 1950s there were over a hundred cases. The number of cases fell in the 1960s when there were only 27 cases. After that, anthrax has been diagnosed in Finland in 1974, 1988 and 2004, with the latest case being in 2008. Cases have been found throughout Finland, but most of them have been in the regions of Uusimaa and Western Finland. The latest cases were found in separate cattle herds.

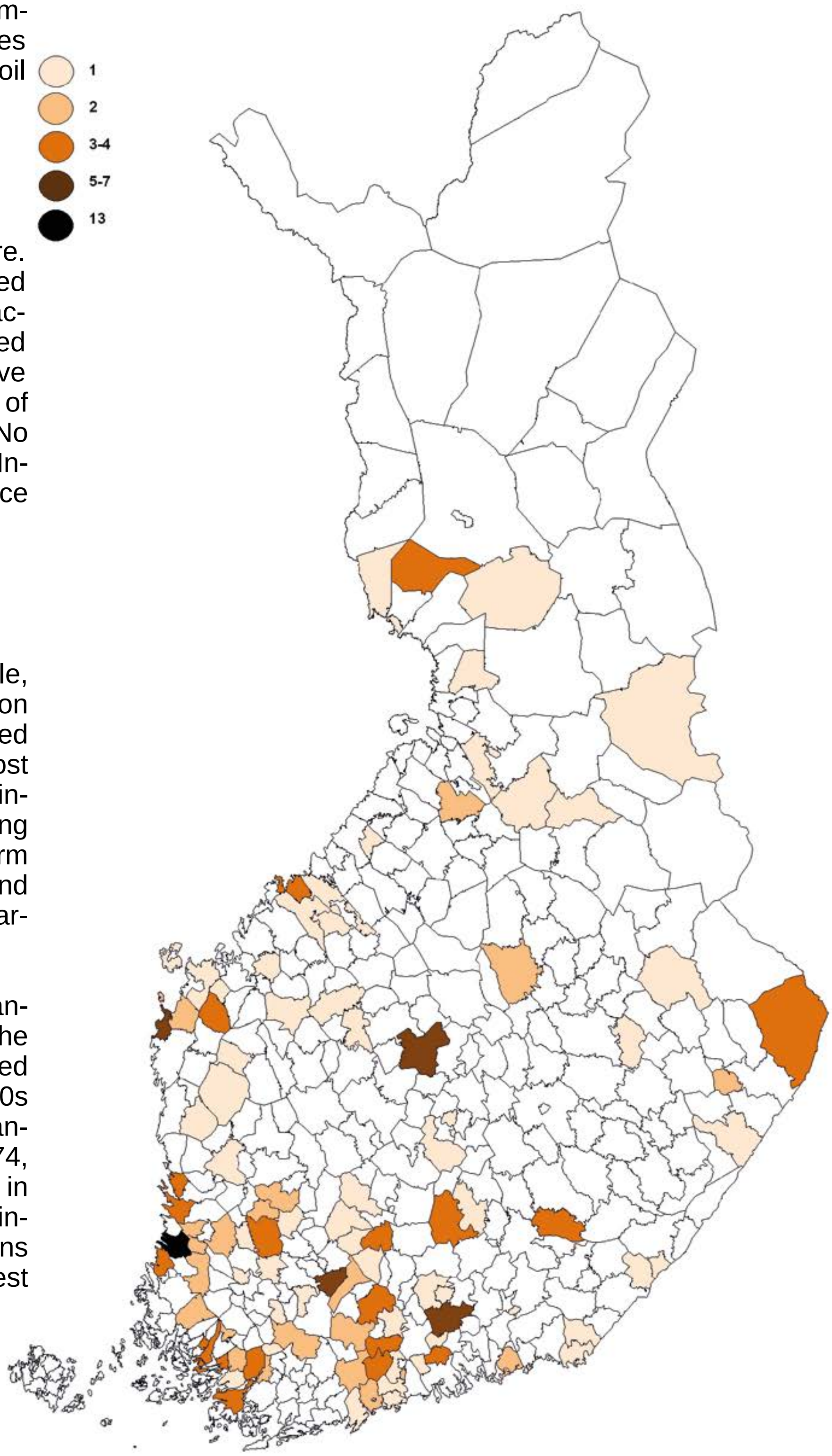


***Figure:** Anthrax cases confirmed with laboratory tests in Finland since 1940, indicated as the number of cases per municipality (latest confirmed case in 2008). (Source: research statistics, VELL, EELA, Evira)*

Case report – anthrax at a cattle farm in Southern Finland

At a cattle farm in Southern Finland, a cow aged 1.5 years became sick in autumn 2004. The animal was in pain and had fever. A veterinarian attended to the cow on the same day, but it died a few hours later. The next day, the veterinarian autopsied the carcass in the field, but he did not observe findings typical of anthrax. Only the intestinal areas presented changes. The gangrenous part of the intestines and the changed sections of the mesentery including lymph nodes were sent to the National Veterinary and Food Research Institute for examination. Plenty of growth similar to the bacterium *B. anthracis* was found in the bacterial culture of the lymph nodes. The diagnosis was confirmed by PCR. The bacterial strain was found to have genes that coded for both capsule and toxins.

At the farm, two cows died at around the same time. In one cow, the disease was diagnosed by organ cultures and in the other directly by PCR from formalin fixated tissue. The probable origin of the disease is green fodder contaminated by soil. The previous summer and autumn had been very wet and a nearby river had flooded the field.

At the same farm in Southern Finland, an anthrax infection was also diagnosed in a young bull in autumn 2008. The animal did not have clinical symptoms conforming to anthrax, but due to infection it was treated by a veterinarian. There was also another sick cow with a fever at the same farm with the bull. No cow has died of the infection. No infections in humans were related to the cases.

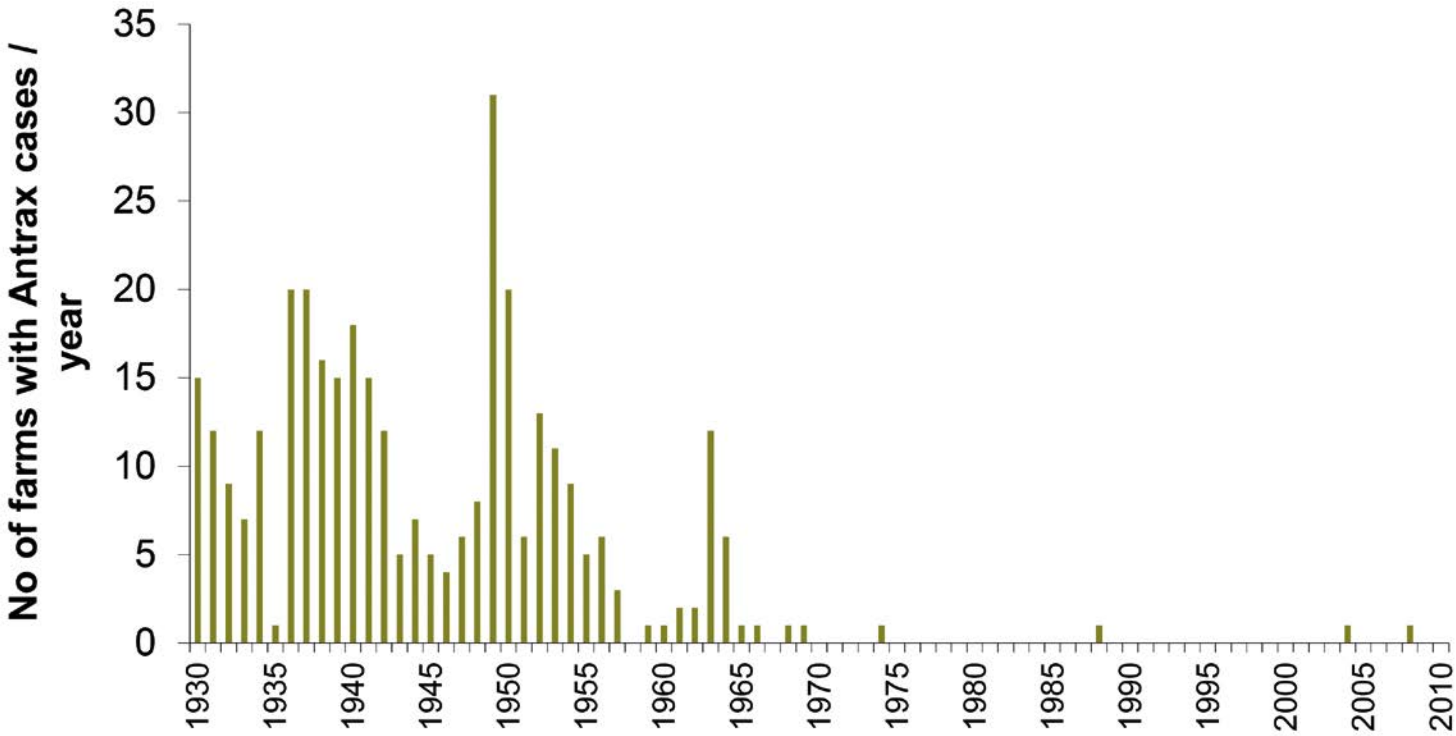


Figure: *Anthrax cases confirmed with laboratory tests in Finland since 1930 (the latest case in 2008). (Source: research statistics, VELL, EELA, Evira)*

5.10. Psittacosis

Psittacosis (ornithosis) is an infectious disease caused by a bacterium called *Chlamydophila psittaci* (*Chlamydia psittaci*) carried by several wild and tame birds, most often doves and parrots. The bacterium has several different strains, and they are very different with respect to their virulence. In humans, psittacosis is also called parrot fever.

5.10.1. Psittacosis in humans

Parrot fever (psittacosis or ornithosis) causes a respiratory tract infection. The disease is contracted in direct contact either through aerosols of bird secretions or faeces, and through feathers.
Psittacosis is uncommon in Finland. From 0 to 2 diagnosed cases in humans have been reported to the National Infectious Diseases Register each year.

5.10.2. Psittacosis in animals

In addition to birds, *C. psittaci* also causes disease in other animal species, such as cats, sheep, goats and cattle. They can also act as a vector. In several countries, the infection is a common cause of abortion in sheep and goats, in which case it is called an enzootic abortion. A bird that has recovered from the disease may continue to pose a risk of infection for several months.

In Finland, there have been a few *C. psittaci* infections in animals each year. Infections have been diagnosed in individual wild birds, pet parrots and doves in connection with other examinations. In Finland, animals are examined for psittacosis only randomly, and therefore there is no detailed information about the possible distribution of the disease in Finland.

5.11. Q-fever

Q fever is caused by the intracellular bacterium *Coxiella burnetii*. In addition to humans, Q fever can spread to almost all animal species. The bacterial spores are resistant and can be carried, for example, by the wind.

5.11.1. Q fever in humans

The most common route of infection in humans is through the respiratory tract. It is also possible to be infected from a tick bite. There have been no cases of Q fever where the infection has been contracted in Finland. Cases have been described mainly in travellers. For example, in 2007 and 2008 two, in 2009 one and in 2010 five travel-related cases were diagnosed.

5.11.2. Coxiella burnetii in food

Infection through contaminated, unpasteurised milk is possible, but extremely uncommon. Infection can be prevented by avoiding drinking unpasteurised milk.

5.11.3. Q fever in animals

C. burnetii infection mainly occurs in ruminants (cows, sheep and goats), less often in other animals. Infection is often asymptomatic in animals. However, asymptomatic animals can excrete the bacteria. An animal can excrete the bacteria in its surroundings through milk, urine and faeces. The bacterium is excreted particularly extensively into the afterbirth in connection with giving birth. When drying, the excretions are dusted into air as aerosol spread.

In Finland, individual animals have been previously tested for Q fever, mainly in connection with export examinations. The cause of Q fever, the bacterium *C. burnetii*, was found in Finland

5.12. Salmonellosis

for the first time at a cattle farm in 2008. In 2009, the occurrence of Q fever antibodies was investigated in dairy cattle. In connection with the investigation, about 14% of Finland's dairy production cattle were studied, and about 0.2% were found to have Q fever antibodies. The individual cattle herds that tested positive were located in Southern and Western Finland. Compared with the other Nordic countries, such as Sweden and Denmark, the prevalence of Q fever antibodies in dairy cattle is clearly lower in Finland.

In 2010, the occurrence of Q fever antibodies was investigated in sheep and goats. Blood samples form sheep and goats representing few dozens of flocks were investigated, all with negative results.

Salmonellosis is a disease caused by an intestinal bacterium, which is part of the *Salmonella* family. Salmonella spreads through faecal contamination. Mammals, birds and reptiles can act as asymptomatic carriers of the bacterium. They may spread Salmonella through their excrement into the environment where it survives for a long time.

The Salmonella family harbour about 2,500 different serotypes. Many of these serotypes differ from one another in terms of their virulence and survival in the environment. The most common Salmonella serotype in Finland is Typhimurium. Its phage type FT1 is endemic in Finland and it is occasionally found in different animal species. Ty-

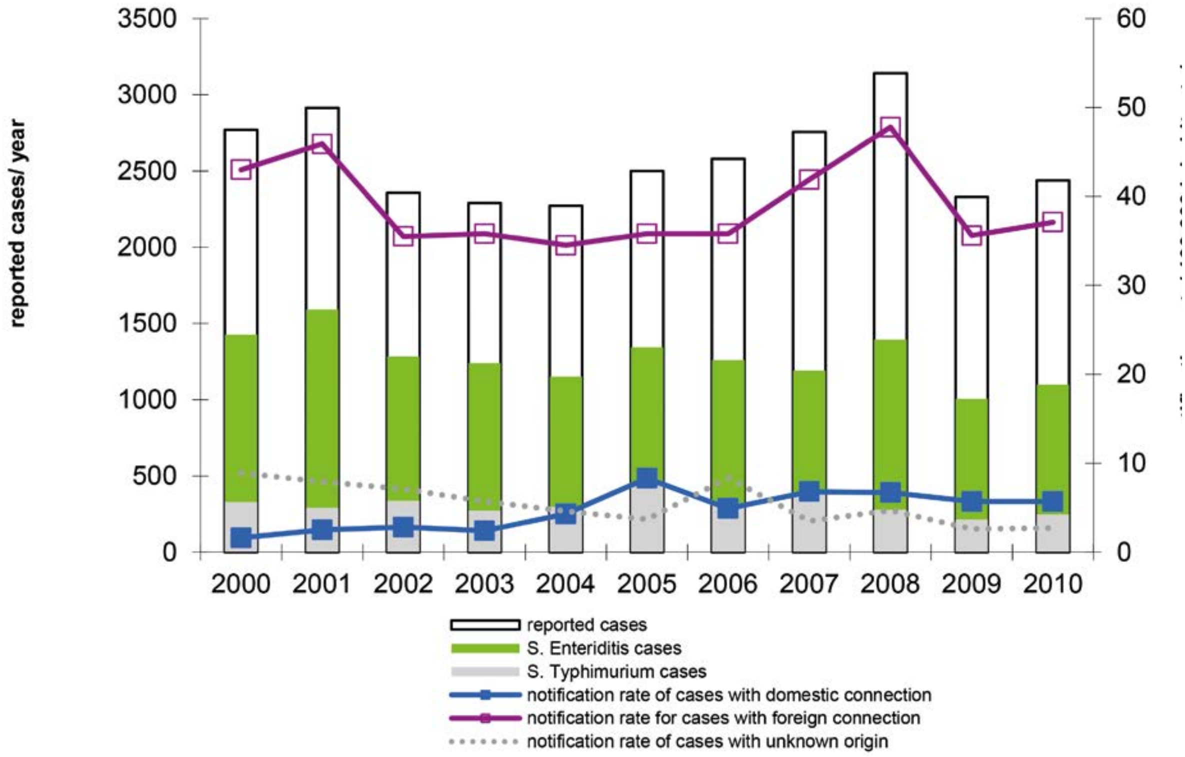


Figure: *Reported cases of salmonellosis (including S. Typhi and S. Paratyphi) in people in 2000–2010 (Source: National Infectious Diseases Register, THL)* phimurium phage type FT41 is typical to seagulls while phage type FT40 is typical to small birds visiting the bird table, from where it is easily spread, e.g. to domestic pets. Phagetype FT104 is of a concern since it is resistant to many antibiotics. Enteritidis is a globally important serotype and the second most common serotype in Finland. Infantis has been one of the endemic serotypes, but recently it has become less common.

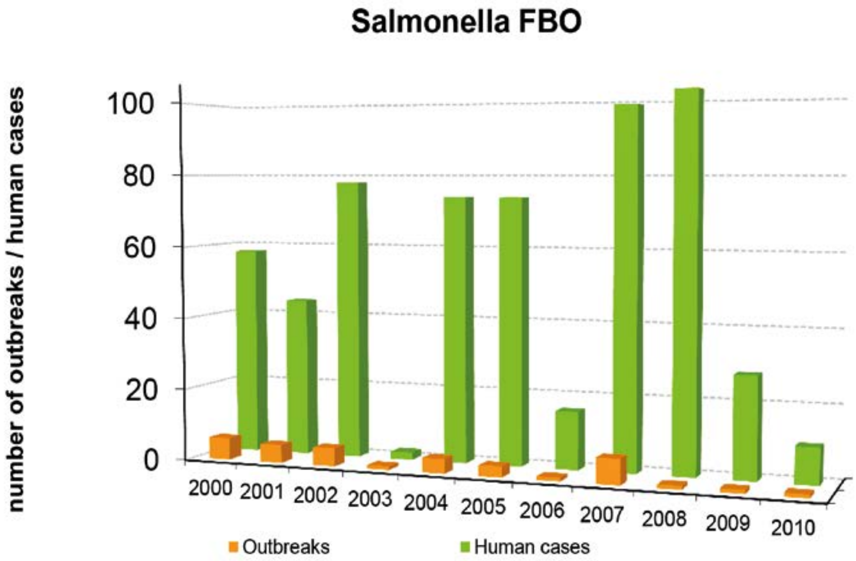


Figure: *Reported food-borne outbreaks caused by Salmonella in 2000–2010 (Source: Food-borne Outbreak Register, Evira)*

5.12.1. Salmonellosis in humans

A Salmonella infection may result in serious acute gastroenteritis, and it is usually the result of eating food contaminated by faeces. According to the Communicable Diseases Decree, a *Salmonella enterica* infection in humans is specified as a generally hazardous communicable disease.

In the 2000s, 2,000–3,000 cases of salmonellosis diagnosed in Finland were reported to the National Infectious Diseases Register each year. The percentage of domestic infections has been about 15% and those related to travelling approximately 80%. The country where the person got infected was not reported in about 5% of the cases. The most commonly diagnosed Salmonella serotypes were *S.* Enteritidis, *S.* Typhimurium, *S.* Stanley, and *S.* Virchow. The majority of domestic infections were caused by the *S.* Typhimurium serotype and those from abroad by the *S.* Enteritidis serotype.

Between 2005 and 2010, 1–7 food-borne outbreaks caused by Salmonella were reported to the Food-borne Outbreak Register each year.

5.12.2. Salmonella in food

Food at retail

Salmonella monitoring of meat is based mainly on a control program that includes sampling of meat at the slaughterhouses and at the meat cutting plants. Therefore, the monitoring of salmonella at the retail level has been based on surveys done from time to time. The surveys have focused mainly on broiler meat, monitoring also focused on pork and, for example, kebab meat. In addition to meat, cheeses, vegetables, shellfish and scallops were tested for Salmonella, as well as spices in which no Salmonella bacteria have been found.

When about 10% of raw chicken meat pieces were found to carry Salmonella bacteria in 1989–1994, there was no Salmonella found in any of the poultry meat samples examined in 2000–2004. The situation has been improved by the introduction of the Salmonella control programme in 1995 and further the improvement of the sensitivity of the control programme in 1999. This has probably contributed to the reduction in the occurrence of Salmonella in Finnish poultry meat.

When consignments of beef, pork, poultry meat and meat preparations at intra-community trade were examined for Salmonella in 2003, Salmonella was found in 3.6% of the examined consignments. Of these examined consignments, 72% were covered by the special guarantees for salmonella, and 3.6% of those were found to have Salmonella as well.

The kebab meat samples collected from restaurants and meat establishments in 2001 contained no Salmonella although in the same year Salmonella was found in raw kebab meat produced in Holland in connection with a food-borne outbreak. In connection to the outbreak investigation, several Salmonella serotypes: *S.* Manhattan, *S.* Lexington, *S.* Kottbus and *S.* Bredeney, were found in one of the related and more contaminated kebab meat batch. In the less contaminated batch, only *S.* Manhattan was found.

Other food

Poultry meat and eggs

The occurrence of Salmonella in broilers, turkeys and laying hens is mainly monitored during the breeding phase of the animals. In addition to monitoring the occurrence, the objective is to detect a Salmonella infection at an early stage before the

	Year	Number of samples analysed	Salmonella (%)
Meat and meat products			
▪ **Poultry**			
chicken carcass'	2008	369	0
poultry meat	2004	130[2)]	0
poultry meat	2000	161[1)]	0
▪ **Pork**			
pork	2000	167[3)]	0
▪ **Other**			
meat and raw meat preparations	2003	608/ 304 batches*	2.1 / 3.6
kebab meat	2001	220[4)]	0
Fruit-sprouts-vegetables			
▪ **Strawberries**	2004	142 (29 farms)	0
▪ **Vegetables-fruit juices-sprouts**			
packed, peeled, cut	2002	33[5)]	0
Fishery products			
▪ **Shellfish and scallops**			
cooked	2003	119[6)]	0
Dairy products			
▪ **Cheeses**			
soft/semi-hard, raw milk	2004	60 / 30 batches[7)]	0
soft/semi-hard, raw milk	2004	90 / 18 batches[8)]	0
Other			
▪ **Spices**	2004	110 / 22 batches[9)]	0

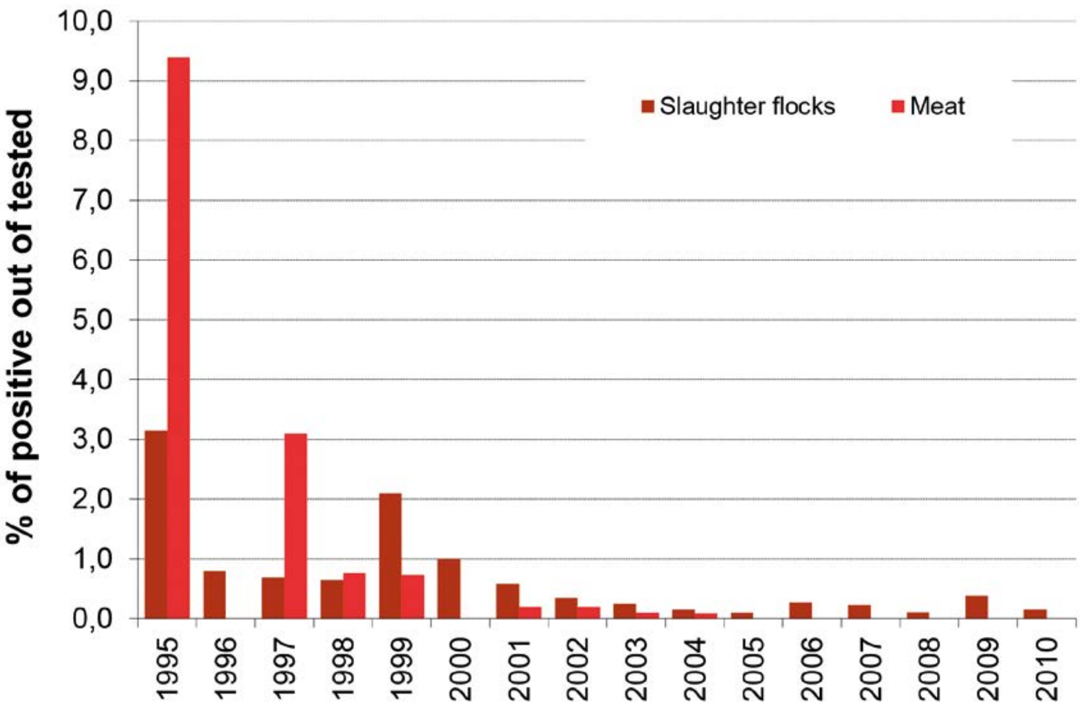
1) of the samples, 160 Finnish, 1 from another EU country and 1 from a third country; 2) of the samples, 125 Finnish, 5 originating from other EU member countries; 104 chickens and 26 turkeys; 3) of the samples, 165 Finnish, 2 originating from other EU member countries; 4) of the samples, 112 Finnish, 16 originating from other EU member countries, no knowledge of the country of origin with respect to 92 samples; 5) 13 from plant and 3 from retail store; 6) from points of first entry and retail stores; 15 fresh and 104 frozen; 7) from overseas; 2 batches of Finnish; 8) Finnish; sampling from the place of preparation; 9) 8 from import company and 4 from retail store. 'EU-wide baseline study; *internal market trade

***Table:** Salmonella in some foods studied in Finland (Source: Evira)* slaughtering of broilers and turkeys or before the start of laying. The occurrence of Salmonella in poultry meat is examined on the production line of meat cutting plants. The monitoring of occurrence is based on the national Salmonella control programme.

Every broiler and turkey batch is tested for Salmonella before slaughter. Since 2002, less than 0.4% of the slaughtered broiler and turkey flocks have been positive for Salmonella each year. Within an EU-wide baseline study, the occurrence of Salmonella in broiler flocks was investigated in 2005–2006 and in turkeys in 2006–2007. Of the 360 broiler flocks selected for the study in Finland, 0.1% were found to have Salmonella, whereas none of the investigated 133 turkey flocks were found to have Salmonella.

Ten different Salmonella serotypes were found in the broiler production farms in the 2000s, with the most common ones being *S.* Infantis and *S.* Livingstone. Turkeys were found to have eight different Salmonella serotypes, with the most common being *S.* Typhimurium.

From just over 300 to over 1,200 poultry meat samples of hens, broilers, turkeys, guinea fowls, ducks and geese have been analysed in meat cutting plants each year. Of the samples analysed each year, less than 0.2% have been positive for Salmonella. Since 2004, there have been no positive poultry meat samples. In the 2000s, the poultry meat samples were found to have three different Salmonella serotypes, with the most common being *S.* Infantis.



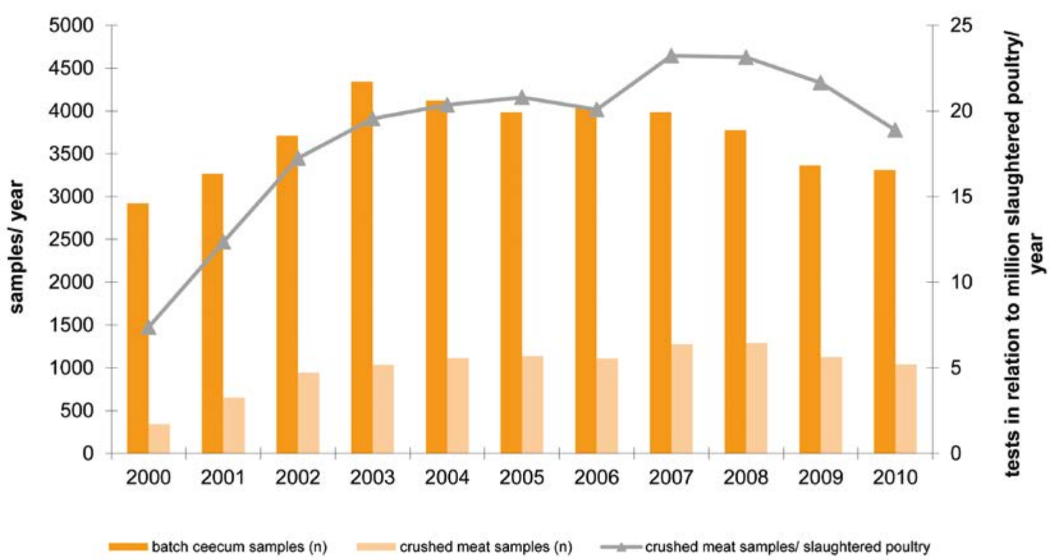


***Figure a-b:** The occurrence of Salmonella in slaughtered poultry flocks and poultry meat (a), Salmonella investigations related to poultry meat production in the 2000s (b) (Source: National Salmonella Control Programme, Evira)*

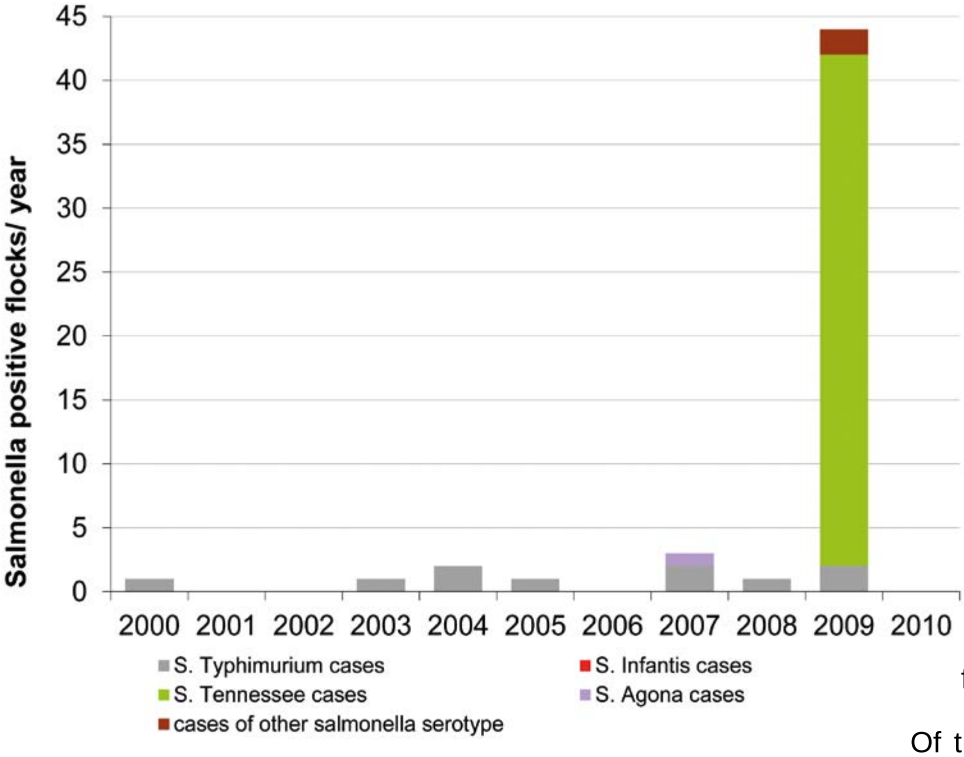


***Figure:** Salmonella findings in laying hen flocks related to table egg production in Finland in 2000–2010. (Source: National Salmonella Control Programme, Evira)*

Flocks of laying hens are tested for Salmonella every 15 weeks. Salmonella has been found in 0–2 laying flocks each year. The most common Salmonella serotype found in laying hen flocks in the 2000s has been *S.* Typhimurium. Exceptionally in spring 2009, an infection of *S.* Tennessee spread through feed was diagnosed in 25 laying hen flocks.

Within the scope of an EU-wide baseline study, the prevalence of Salmonella in laying hen farms was analysed in 2004–2005. Of the 250 laying hen farms selected from Finland for the study, 0.4% were found to have Salmonella.

In relation to the investigation of Salmonella contamination spread to farms via feed in 2009, the eggs from 34 laying hen farms were also investigated, and no Salmonella was found in the eggs.

Pork

The occurrence of Salmonella in slaughter pigs is monitored from intestinal lymph node and carcass-surface swab samples taken in connection with slaughtering, and from meat samples taken on the production lines of meat cutting plants. The monitoring of occurrence is based on the national Salmonella control programme. The samples are collected as random sampling. About 3,000 lymph node samples of both fattening and breeding pigs have been examined each year.

Of the pig lymph nodes analysed each year, 0.2% or less have tested positive for Salmonella. Within the scope of an EU-wide baseline study, the prevalence of Salmonella in slaughter pigs was analysed in 2006–2007. Not one of the lymph nodes of the 419 pigs selected for the study in Finland tested positive for Salmonella.

Of the pig carcass-surface swabs analysed each year, less than 0.1% have tested positive for Salmonella. In 2000 and since 2004, no pig carcass has tested positive for Salmonella. In the 2000s, Salmonella has been found in pork samples taken from the production lines of meat cutting plants only in 2002, 2003 and 2007 when their percentage was below 0.1.

In the 2000s, a total of 14 different Salmonella serotypes were found in samples taken in pig slaughterhouses and meat cutting plants, with *S.* Typhimurium being the most common one.

Beef

The occurrence of Salmonella in slaughter cattle is monitored from intestinal lymph node and carcass-surface swab samples taken in connection with slaughtering and from meat samples taken on the production lines of meat cutting plants. The monitoring of occurrence is based on the national Salmonella control programme. The samples are collected as random sampling. An average of 2,273 meat samples of cattle have been taken in meat cutting plants each year.

Of the cattle lymph nodes analysed each year, 0.3% or less have tested positive for Salmonella. Of the cattle carcass-surface swabs analysed each year, 0.3% or less have tested positive for Salmonella. Since 2006, no cattle carcass has tested positive for Salmonella.

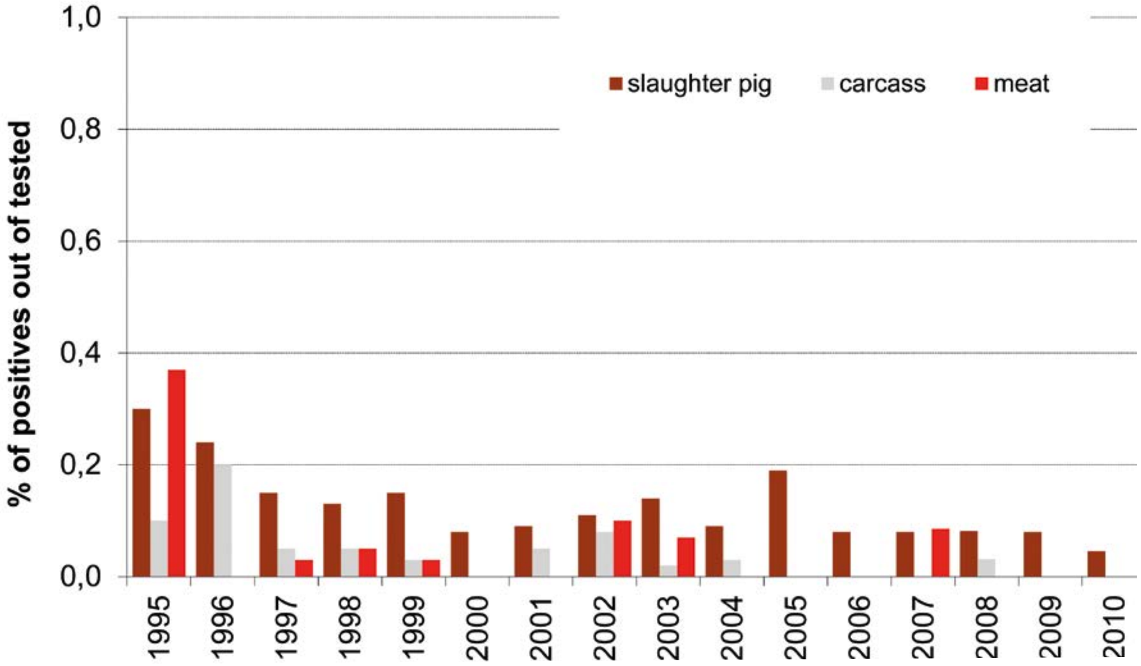
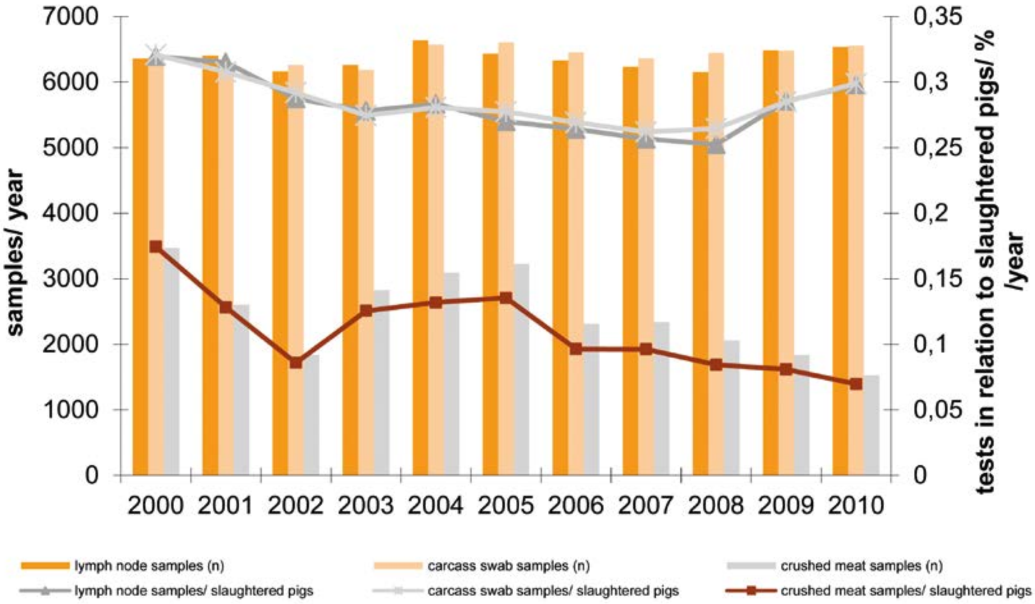


Figure a-b: The occurrence of Salmonella in slaughter pigs, pig carcasses and pork (a) Salmonella investigations related to pork production in 2000–2010 (b) (Source: National Salmonella Control Programme, Evira)



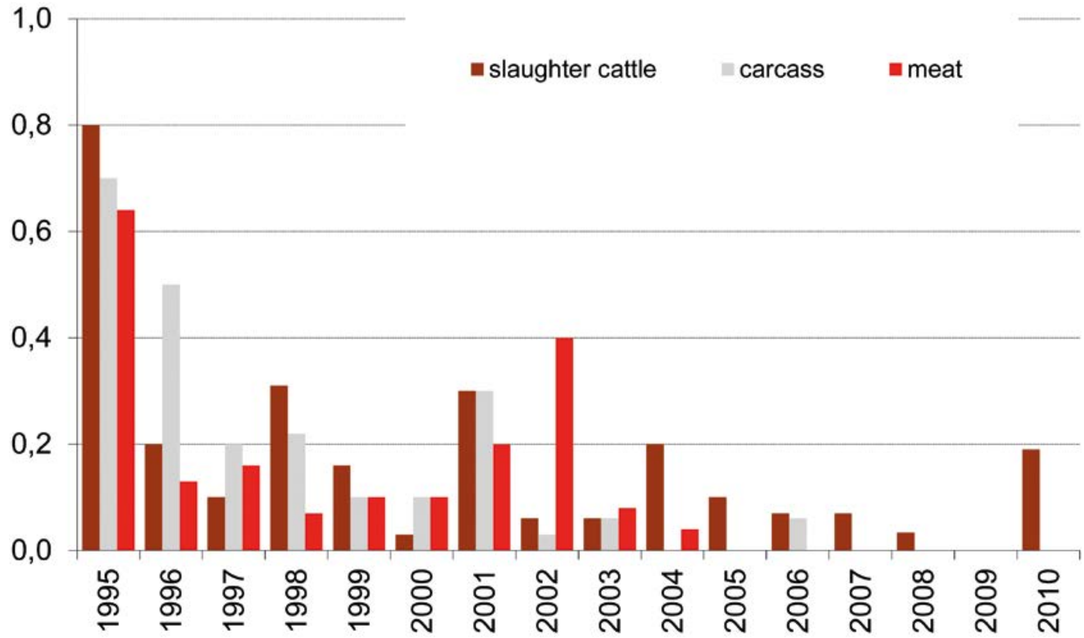


***Figure c:** The occurrence of Salmonella in cattle, cattle carcasses and beef (Source: National Salmonella Control Programme, Evira)*

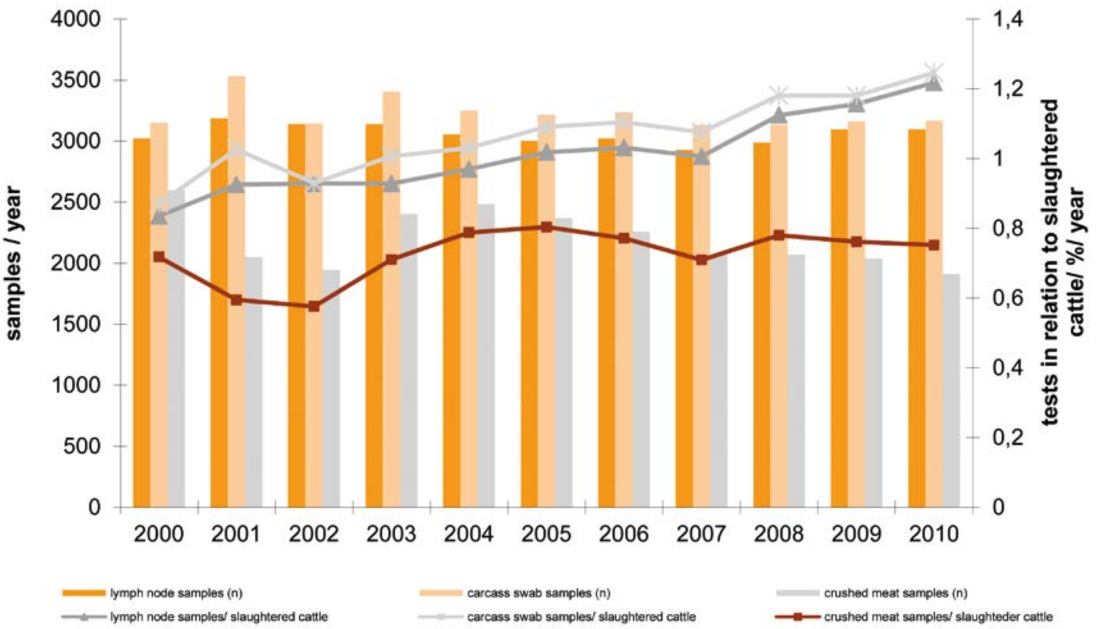


***Figure:** Salmonella investigations related to beef production in 2000–2010 (Source: National Salmonella Control Programme, Evira)*

Of the beef samples taken on the production lines of meat cutting plants, Salmonella has been found in 0.4% or less of the tested samples in the 2000s. Since 2004, no meat sample has tested positive for Salmonella.

In the 2000s, a total of 7 different Salmonella serotypes were found in samples taken in cattle slaughterhouses and cutting plants, with *S.* Typhimurium being the most common one.

5.12.3. Salmonella in animals

Salmonella infections do not usually show clinical signs in the animals. To protect themselves against Salmonella infections, the majority of broiler farms in Finland are using voluntary CE (competitive exclusion) treatment. The treatment aims to prevent the attachment of the Salmonella bacteria to the intestines of chicks and to increase their resistance. In Finland, the method has been applied successfully to combat Salmonella in poultry since the 1970s.

Poultry

Monitoring of the occurrence of Salmonella in poultry is based on the national Salmonella control programme. Breeding flocks of hens, broilers and turkeys are examined as day old chicks once they arrive at the rearing units, at the age of 4 weeks, and two weeks before moving them to the laying unit. Adult breeding flocks are examined every two weeks at the farm or at the hatchery.
In the 2000s, Salmonella has been detected three times in broiler breeding flocks and six times in turkey breeding flocks.

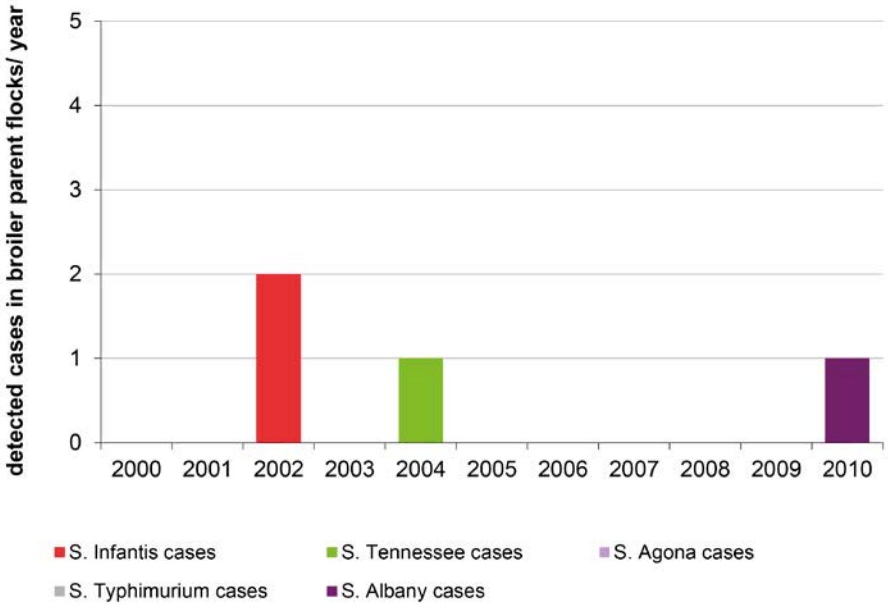
In 2003, the turkey parent flocks testing positive for *S.* Typhimurium were being reared at the same time. The source of infection was traced based on an environmental hygiene sample taken in the hatchery that indicated infection. *S.* Typhimurium FT1 infection was also found in the chicks of the hatch.

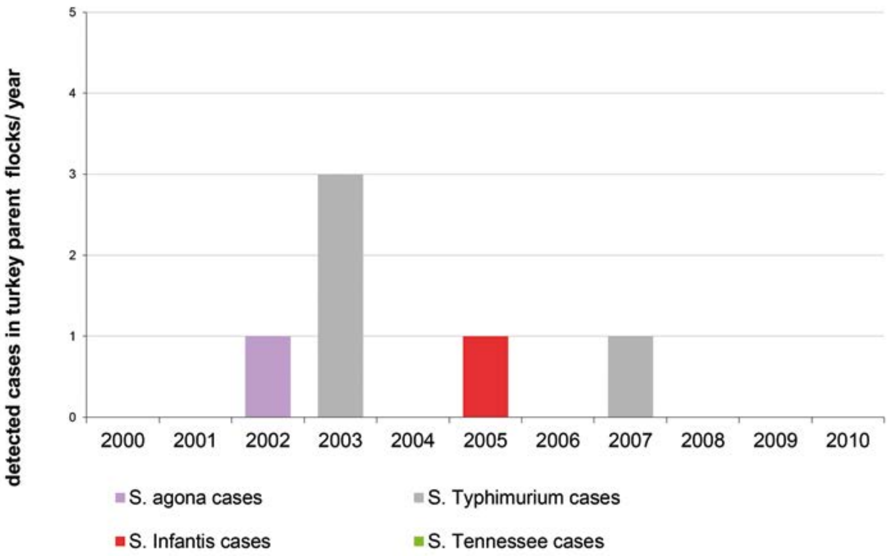
Within an EU-wide baseline study, the prevalence of Salmonella in turkey breading flocks was investigated in 2006–2007. None of the 15 turkey breeding flocks selected for the study in Finland tested positive for Salmonella.

The Salmonella tests on the rearing flocks of laying hens are started at the hatchery where some of the hatched chicks are examined with basket liner or skin swabs. The rest of the day-old chicks are examined after they have arrived at the rearing unit. Depending on the rearing form, boot or faeces samples, as well as a dust sample taken by the supervising authority are examined in the rearing and production units. Exceptionally in spring 2009, an infection of *S.* Tennessee spread through feed was diagnosed in 15 rearing flocks of laying hens. Otherwise, Salmonella has been detected in rearing flocks of laying hens only once, in the 2000s, when *S.* Typhimurium was found in one flock in 2003.

Salmonella was detected twice in the rearing or adult breeding flock of the egg production line in the 2000s. In 2004, *S.* Typhimurium was found in an adult breeding flock, and in 2007, *S.* Heidelberg was detected during import quarantine in a chick flock designated for production.

__Figure a-b:__ Salmonella findings at broilers (a) and turkey breeding flocks (b) in the 2000s based on faecal samples. (Source: National Salmonella Control Programme, Evira)





Pigs

Monitoring of the occurrence of Salmonella on pig farms is based on Salmonella tests on the faecal samples collected from boars sold to artificial insemination stations and their herds of origin. Salmonella is also always tested when suspecting a Salmonella infection on a pig farm.

On pig farms in the 2000s, Salmonella was found in 2000, 2003–2004, 2007, 2009 and 2010. In 2000, an *S.* Infantis infection was diagnosed both in the pigs and cattle of a combined production farm. In spring 2009, a *S.* Tennessee infection spread through feed was diagnosed in the pigs of 12 pig farms, in two of which the infection was still found in 2010. In the 2000s, a total of 5 different Salmonella serotypes were detected on pig farms.

Within the scope of an EU-wide baseline study, the prevalence of Salmonella in farms with breeding pigs was analysed in 2008. None of the 207 pig farms selected for the study in Finland tested positive for Salmonella.

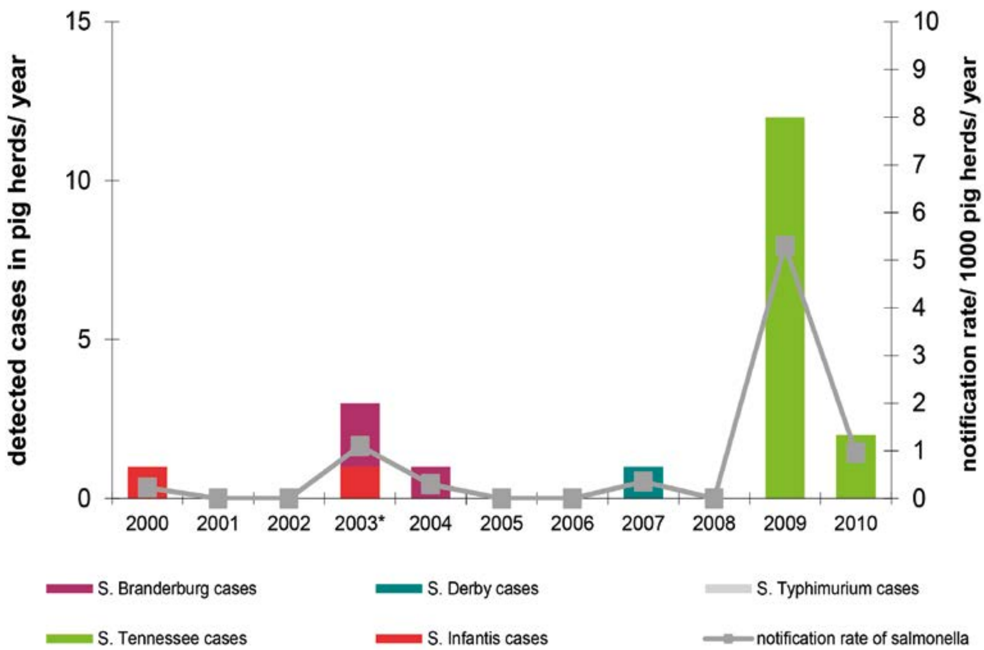


*__Figure c:__ Salmonella findings on pig farms in 2000–2010 based on faecal samples (*2003 positive pig farms totalled 4, with one presenting two different Salmonella serotypes; 2010 infections already diagnosed in 2009) (Source: Evira)*

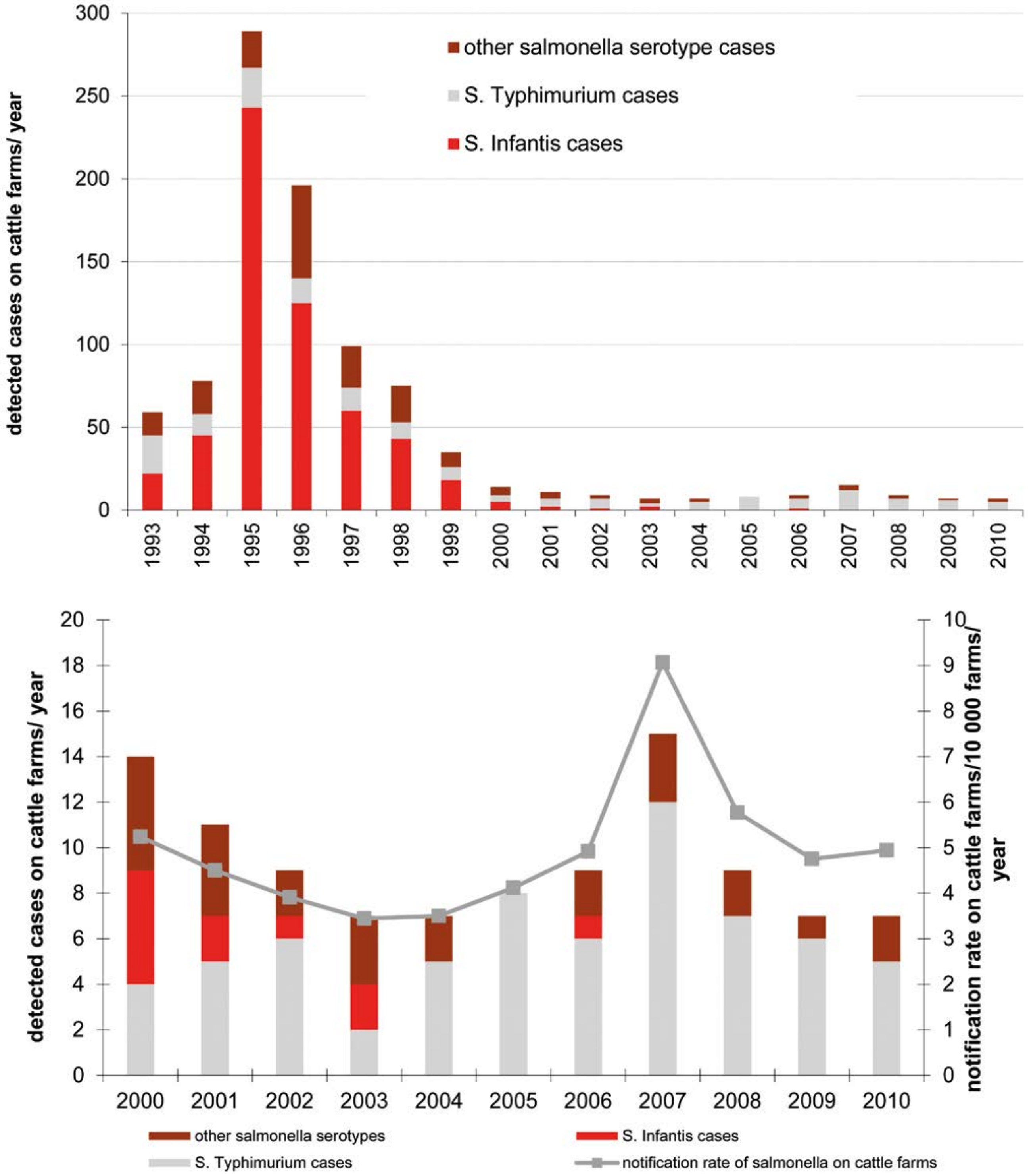


Figure a-b: *Salmonella findings in cattle (a) since 1993 (b) 2000–2010 based on faecal samples (Source: Evira)*

Cattle

Monitoring of the occurrence of Salmonella in cattle is based on Salmonella tests on the faecal samples taken from bulls sold to artificial insemination stations and their herds of origin and in connection with other animal trade.

Salmonella is also always tested when suspecting a Salmonella infection on a cattle farm.

In the 2000s, there were around ten (7–15) herds of cattle that have tested positive for Salmonella from faeces samples each year.

In the 2000s, a total of 13 different serotypes of the *Salmonella* enterica subsp. enterica subspecies were found on cattle farms, with the most common being *S.* Typhimurium. Moreover, the *Salmonella* enterica subsp. diarizonae subspecies was found twice in cattle farms.

In 2004, *Salmonella* ssp. IIIb (=subsp. diarizonae) was detected in bulls to be sent to the artificial insemination station. Before that only *Salmonella* enterica subsp. enterica subspecies strains had been isolated from Finnish cattle. Earlier isolations of the *Diarizonae* subspecies had mainly been from poikilothermic animals (e.g. lizards, snakes, tortoises). Another strain of the same subspecies was also isolated from dairy cattle in 2007.

Horses

In addition to production animals, Salmonella strains were isolated from horses, and epidemic outbreaks have also occurred among them.

Salmonella in other animals

In addition to production animals, Salmonella strains have been isolated from samples of wild animals, pets, zoo animals and other hobby animals. In the 2000s, about 50–150 of these kinds of strains were confirmed each year, and about 60 different Salmonella serotypes were found in them. *S.* Typhimurium has clearly been the most commonly isolated serotype, with *S.* Enteritidis being the next most common serotype.

Almost one-third of the strains isolated and typed from other animals in 2001–2004 and about 10–20% of those in 2005–2008 were part of a subspecies other than the *S.* enterica subsp. enterica subspecies (subsp. salamae, subsp. arizonae, subsp. diarizonae and subsp. houtenae). Almost all of these strains originated from tortoises, snakes or lizards.

5.12.4. Salmonella in feed

Salmonella bacteria are prevented from entering foodstuffs by monitoring the occurrence of Salmonella in animal feed. This aims to prevent Salmonella infections in both humans and animals. Plant-derived feed materials from overseas are regarded to carry a particularly high risk in terms of Salmonella. According to feed legislation, Salmonella must not be found in feed.

The information on the occurrence of Salmonella in feed is based on official feed control studies and the quality assurance testing of the feed industry.

A *S.* Infantis outbreak in cattle farms, spread through feed, was discovered in 1995. During the outbreak, the infection was diagnosed in about 0.7% of Finnish cattle farms. In spring 2009, a *S.* Tennessee outbreak spread through feed given to poultry and pigs. The infection was diagnosed in about 4% of Finnish hen houses and in about 2% of Finnish pig farms.

Feed arriving in Finland

The information about the occurrence of Salmonella in feed arriving in Finland is based on official feed control testing. Feed batches in which Salmonella is found are treated before releasing them on the market, or they are destroyed or returned to the country of origin.

In the 2000s, an average of 340 million kilos of plant-based feeds arrived in Finland each year, and on average just under 8 per cent of these were found to be contaminated with Salmonella. The majority of plant-based feed material, about 73%, consisted of products or by-products of the seeds of oil plants (such as soy bean and rape meal). Of these feed materials, almost 10% were found to be contaminated with Salmonella. The highest amounts of feed material contaminated with Salmonella arrived in Finland in 2002 and 2004. The most common serotypes found in plant-based feed were *S.* Tennessee, *S.* Agona, *S.* Senftenberg and *S.* Mbandaka.

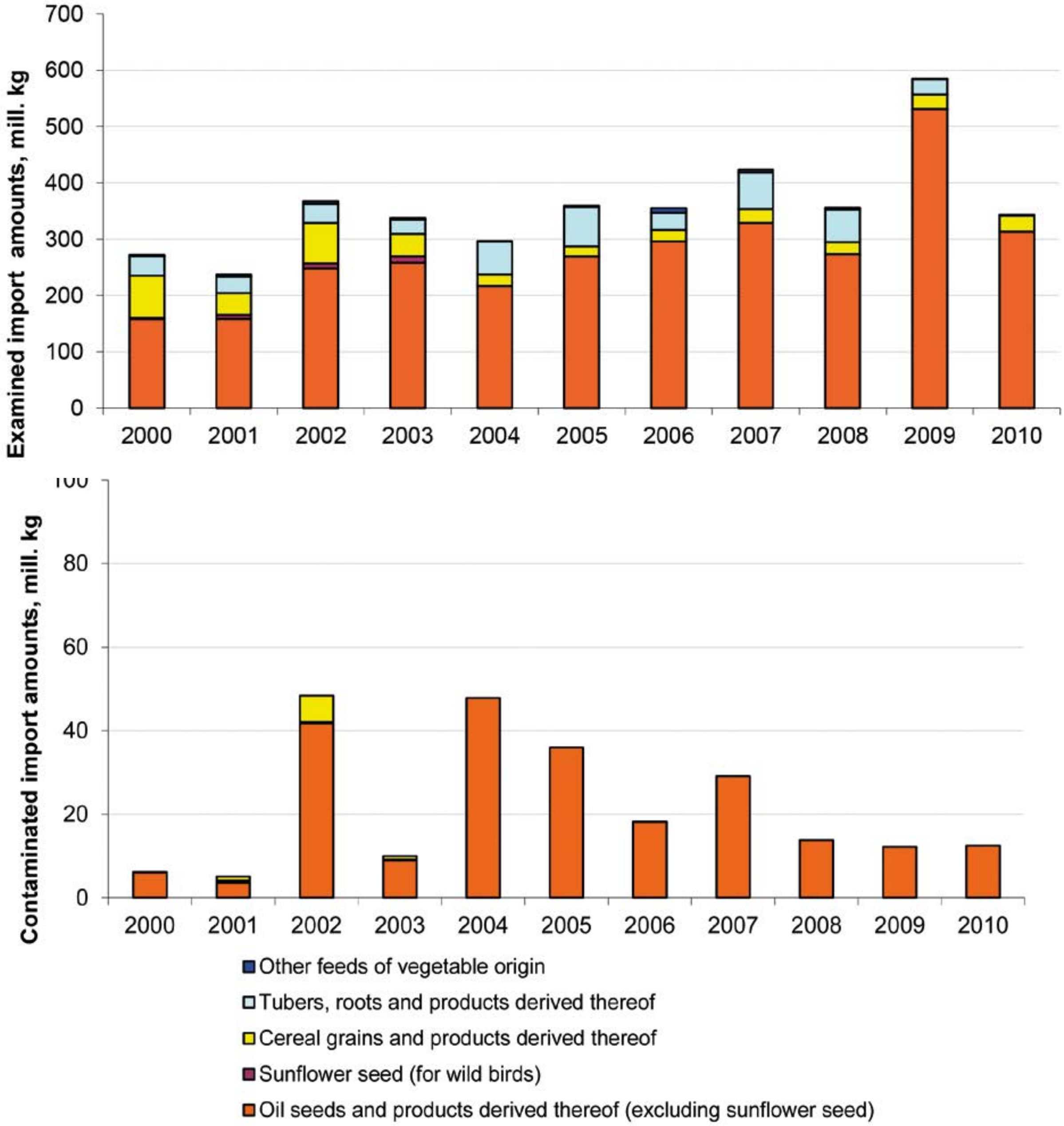


Figure: *Salmonella testing on feed and feed materials that arrived in Finland in 2000–2010 (Source: Feed Control, Evira)*

Finnish feed production

The information about the occurrence of Salmonella in Finnish feeds is based on official feed control testing. The official sampling frequency is based on the production volumes and the nature of products, and it is carried out on final products. Moreover, feed producers perform Salmonella analyses to ensure the quality of products. If Salmonella is found in mixed feeds in connection with production, the production in the contaminated production line is stopped for cleaning. The source of contamination is ascertained and the contaminated feed is traced.

Based on the reports by the feed industry, an average of 480 million kilos of plant origin and 150 million kilos of animal origin feed materials were produced or manufactured in Finland each year in the 2000s. At the same time, an average of 1,430 million kilos of mixed feeds for production animals, 380 million kilos of fresh mixed feeds for fur animals and just under 7.6 million kilos of feed for pets were produced each year.

In the 2000s, Salmonella was discovered three times in feed materials of plant origin produced in Finland: in one batch of rape seed expeller in 2004, in a batch of oats meant for fur animals in

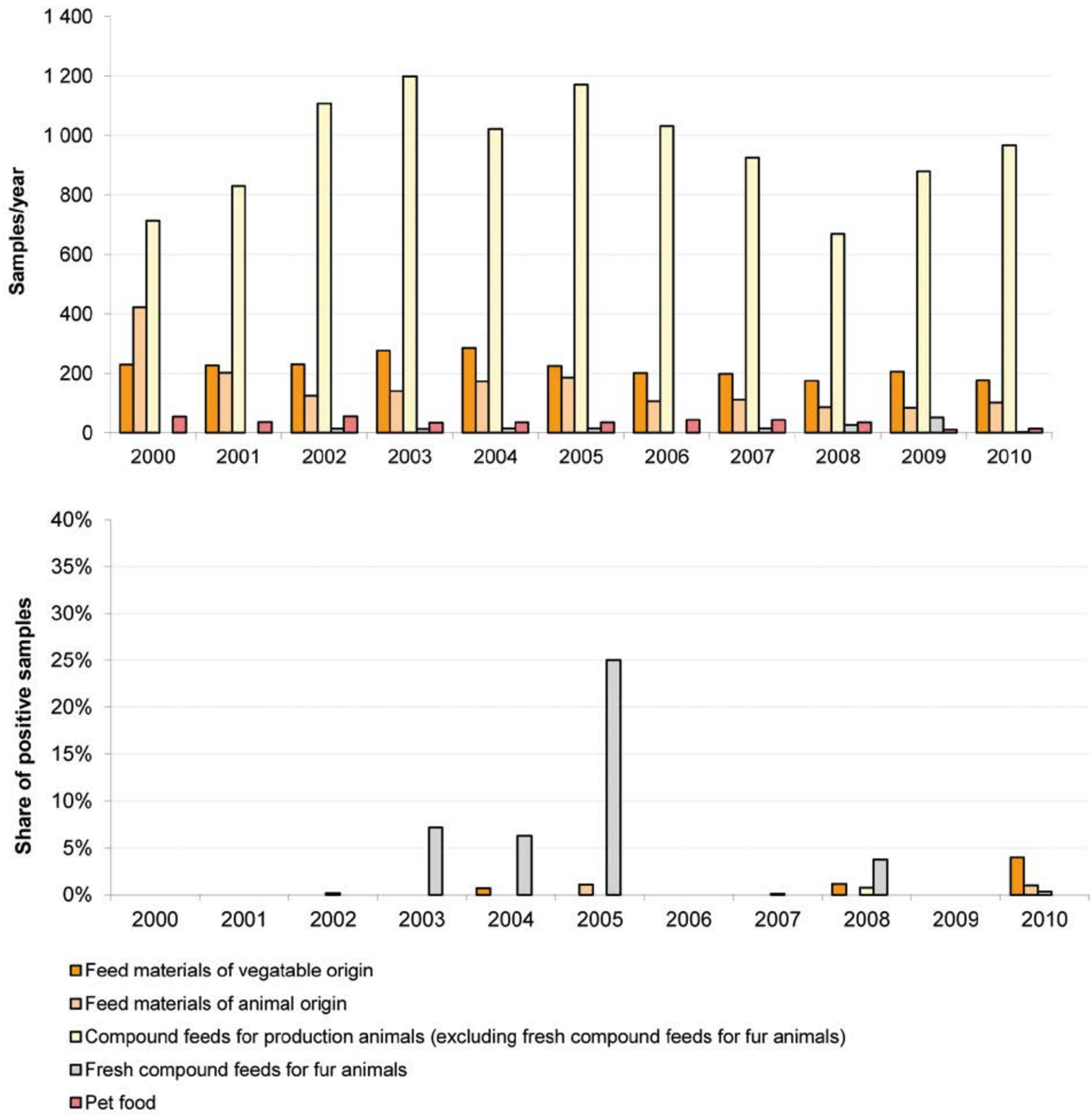


Figure: *Salmonella testing related to the manufacture of feeds in Finland in the 2000s (Source: Salmonella control of feeds, Evira)*

2007 and in two batches of wheat bran in 2008. In animal-derived feed materials, Salmonella was found in two meat-and-bone meal samples in 2005.

In the mixed feeds for fur animals, Salmonella was found in 2002–2005, 2007 and 2008. No Salmonella was found in samples collected in connection with the manufacture of pet feeds.

The Salmonella types that were most frequently isolated from the control samples of the production of feeds were *S.* Agona and *S.* Poona, which were isolated from feeds meant for fur animals. *S.* Tennessee was found in the feed meant for laying hens and pigs in 2009.

Feeds on the market

Feeds available on the market are tested in connection with controls on trade, storage, handover and use as so-called market control. The Salmonella sampling of market control has focused on the feeds of all animal species.

The most considerable part of Salmonella studies has focused on pet feeds. An average of 3.5% of dried pig's ears and other similar products meant for dogs and an average of 1.3% of other pet feeds have been contaminated with Salmonella. The contaminated feeds have mainly been produced elsewhere than in Finland. Of the plant-derived feeds, Salmonella has been found in sunflower seeds meant for the feeding of wild birds. However, there have been fewer contaminated sunflower seed lots than in the previous years.

The most common serotypes isolated from dried pig's ears and other similar products meant for dogs have been *S.* Typhimurium, *S.* Derby, *S.* Anatum and *S.* Havana. All in all, 34 different serotypes of Salmonella have been identified in the pig's ears and other dog chews.

In the 2000s, there was one Salmonella finding in the Finnish feeds for production animals that are part of the food chain. In 2006, *S.* Typhimurium was found in the farm mixture for cattle produced by a mobile mixer.

5.12.5. Significance of Salmonella in Finland

Until 1999, the Salmonella bacteria were the most common cause, and in the 2000s the second most common bacterial cause of intestinal

Case report – a feed-borne Salmonella outbreak on food production animal farms

In late February 2009, a *Salmonella* Tennessee infection was detected on two egg-producing farms in sampling related to the Salmonella control programme. In early March, the source of infection was found to be the poultry feed manufactured in Finland. *S.* Tennessee was also found in pig feed which had been produced on the same production line with the poultry feed. Evira banned manufacturing of feed on the production line in question and placing of the feed produced on the line on the market, and gave an order to withdraw the products from the market.

In order to establish the extent of the infection, samples were collected from all of the pig and poultry farms where feed produced on the contaminated production line after 12 December 2008 had been delivered. Faeces samples were collected from over 800 farms (288 poultry farms and 546 pig farms) and feed samples from about 600 farms. *S.* Tennessee was found in a total of 50 pig farms, where the bacteria was found in faecal samples of 10 farms and in the environmental or feed samples of 40 farms.In addition, *S.* Tennessee was found in a total of 30 egg-production farms. *S.* Tennessee was also found on one broiler and one turkey farm, but it was not possible to establish the source of infection. The suspected cause of the outbreak was a persistent contamination of *S.* Tennessee in the environment of the production line at the feed plant. It was likely that Salmonella bacteria entered the cooling process of the feed line through air intake, where they multiplied. A new cooler was installed on the production line and other structural changes were also carried out, and it was possible to restart feed production on 13 October 2010. No infections were reported in people in connection with the *S.* Tennessee outbreak. Sanitation measures on the contaminated farms lasted a long time and the measures on the last farms were still continuing in 2010.

infections in humans in Finland. The majority of the Salmonellosis cases in humans found in Finland seem to be related to overseas travel.

Compared with the 1990s, the occurrence of Salmonella in production animals is clearly lower these days. Salmonella bacteria are uncommon in Finnish production animals, and their prevalence is clearly lower than in most other countries. Plant-derived feed materials from overseas are regarded to pose a particularly high risk for production animals. The control programme aims to, e.g. reduce the likelihood that eggs or meat contaminated with Salmonella are accessible to consumers. It is unlikely that meat contaminated by Salmonella produced in Finland would be available in retail trade.

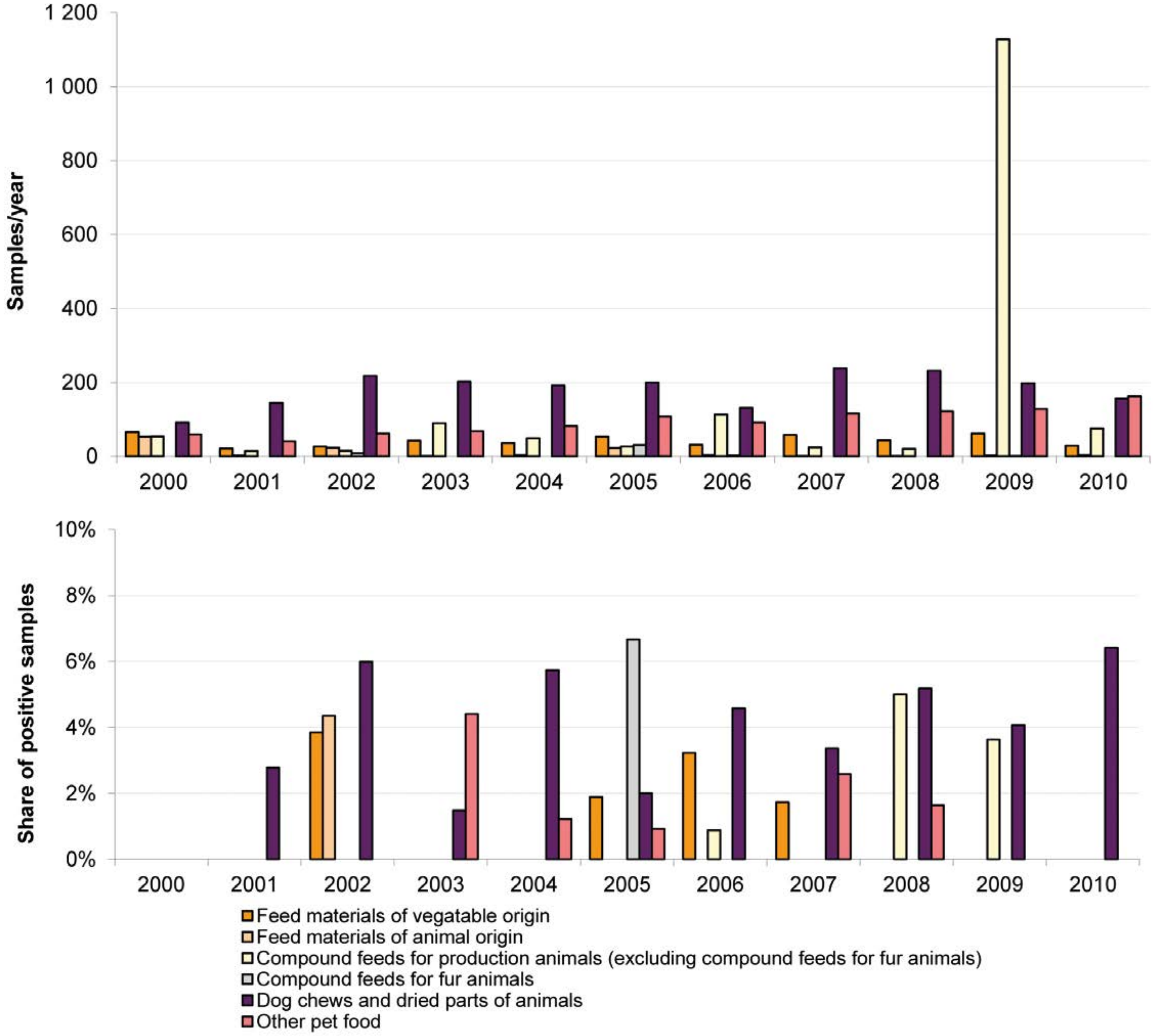


Figure: *Salmonella testing on feed and feed materials on the market in Finland in the 2000s (Source: Salmonella control of feeds, Evira)*

Case reports – examples of food-borne and water-borne outbreaks caused by Salmonella

A water-borne outbreak was discovered in a ski resort in Northern Finland in December 2000. During the Christmas season, it was necessary to take into use the municipal supplementary water supply plant located in the area. Due to a broken seal, the municipal waste water pipe located above it had leaked waste water into the soil, causing contamination of the water in the supplementary water supply plant. About 300 holidaymakers fell ill after drinking contaminated tap water. The majority of those who fell ill had feverless diarrhoea lasting for a few days. Calicivirus was found in the faeces of several people who had the symptoms of this disease. In some, the symptoms were prolonged, and they were found to have *S.* Ohio or *Campylobacter upsaliensis.* The water samples revealed the calicivirus and *S.* Ohio.

Salmonella Oranienburg caused an outbreak of illness in about 300 people in various parts of Europe in 2001–2002. Consumption of chocolate turned out to be a common factor. The same German factory was revealed as the place of manufacture of the contaminated chocolate. The same Salmonella type was isolated from chocolate at least in Germany, Sweden and Finland. Outbreaks related to the consumption of chocolate were also reported in the Netherlands, Canada, Austria, Belgium, Australia and Croatia. In Finland, the quantities of Salmonella detected in two chocolate batches were low. In Finland, nine people were reported to have contracted an infection caused by *S.* Oranienburg. The chocolate batches found to be contaminated were removed from the market.

In Oulu, four domestic cases of Salmonella were discovered within a short period of time in 2004. The people who fell ill had all visited the same local restaurant. In the samples collected from the restaurant in connection with an inspection, *S.* Enteritidis was found in marinated chicken. The Salmonella isolated in four patients was also of the same type. No Salmonella was found in the restaurant staff. It was not possible to trace the contaminated consignment because the original packages had been discarded. However, the restaurant had received Brazilian frozen chicken. The chicken was defrosted, cut up and marinated in the restaurant. The inspection of the restaurant found several deficiencies in the hygiene level and in-house control. There was no hand-washing point where the chicken meat was handled, there were no separate tools for the meat, and the cutting boards were in poor condition. In January 2005, at least six people contracted gastroenteritis caused by the antibiotic-resistant *Salmonella* Enteritidis of the FT40 strain after dining in the same restaurant. The restaurant had been instructed in the correct handling of chicken meat and in hygienic working methods. It was discovered in the inspection carried out that the instructions given during the previous outbreak had been forgotten and several changes had been carried out on the premises that reduced the hygiene levels, for example, the hand-washing points had been removed and the same cutting boards and dishes were used for meat and vegetables.

S. Agona caused an outbreak with 15 confirmed cases in July–August, 2007. Almost half of the persons attending a party in a private home and in a meeting held on consecutive day fell ill (27/58). All three persons involved in preparing of the food served were found to have Salmonella, although only one of them had had symptoms of the disease. Abundant quantity of *S.* Agona was isolated also from a hot-smoked salmon sandwich cake that was served. The origin of the infection was probably an infected person who prepared the food because the preparation of the sandwich cake entailed manual work subject to many high-risk stages in terms of contamination and spreading the infection.

Four infections caused by *S.* Weltervreden were found in Norway in October 2007. When investigating the outbreak, it turned out that there had also been cases of the disease caused by the same Salmonella serotype in Denmark and Finland. Overall, 45 infections were diagnosed, 8 of which were in Finland. It was possible to trace the infections to alfalfa sprouts, which probably originated from Italy and from which a Salmonella strain of identical type was successfully isolated.

A country-wide outbreak caused by *Salmonella* Bovismorbificans was detected in June 2009. Between May and August, *S.* Bovismorbificans was diagnosed in 42 people in different parts of Finland. The outbreak involved 28 confirmed cases. A case-control study carried out by THL found a connection between consumption of alfalfa sprouts and the disease. The sprouts were sold in retail sale in various parts of Finland. The country of origin of the seeds was Italy. The importer had tested the batch for Salmonella with negative results, and the seeds were treated with sodium hypochlorite in the germination facility before germination. When suspicion rose of the contribution of the sprouts as the cause of the outbreak, the seeds and sprouts were collected by the local authorities to be tested for Salmonella. No deficiencies were found in the seed handling or in-house control in the germination facility. During the studies, the batch of seeds was banned from use. Despite extensive tests, no Salmonella was found in the seeds or the sprouts, and the batch was taken back into use. At the same time, in the number of *S.* Bovismorbificans cases reported to the National Infectious Diseases Register of THL, it was possible to see first a reduction of cases and then an increase in the number of cases during the week following the release of batches. For this reason, the seed batch was banned from use once and for all. Isolation of Salmonella was finally successful from the sprouts germinated in Evira's laboratory from the same batch of seeds and from the germination and rinsing water of the sprouts when ten additional samples (á 400 g) were taken from the remaining batch of seeds (about 1,000 kg). Even from these, only one subsample tested positive. No Salmonella was found in the seeds although a total sample of 186 g was tested from the subsample that produced positive sprouts. In addition to the Bovismorbificans serotype, *S.* Umbilo was found in the sprouts and *S.* Szentes in the germinating and rinsing water. No more infections were diagnosed after the sprout batch was removed from the market.

5.13. Erysipeloid

The disease called erysipeloid is caused by the bacterium *Erysipelothrix rhusiopathiae*, which is commonly present in the soil.

5.13.1. Erysipeloid in humans

In humans, *Erysipelothrix rhusiopathiae* causes a skin infection known as erysipeloid after the incubation period of 2–7 days. The disease is usually transmitted through a skin wound or scratch when handling sick animals or fish.

In Finland, occurrence of erysipeloid in humans is not under surveillance at the national level. If *E. rhusiopathiae* causes an uncommon generalised infection where it can be cultured from blood or cerebrospinal fluid, the laboratory finding is reported to the National Infectious Diseases Register.

5.13.2. Erysipelothrix rhusiopathiae in food

Pigs sent for slaughter must not have symptoms of erysipeloid. Erysipeloid diagnosed during meat inspection will result in the rejection and removal of the carcass from use for food.

5.13.3. Erysipeloid in animals

The *E. rhusiopathiae* bacterium in pigs typically causes high fever and blotchy redness of the skin, as well as arthritis and cardiac valve infections. The bacterium can also be contracted by other mammals and birds. In poultry, especially turkeys, the bacterium can cause a serious general infection. The infection is spread through the secretions of animals that are sick or asymptomatic but carrying the infection, through soil contaminated with the bacterium, or through feed.

Erysipeloid diagnosis in pigs is part of the animal diseases that must be reported monthly by virtue of statutory provisions. The number of reported cases has fallen evenly in the 2000s. The reduction in the number of cases in pigs evidently reflects the fact that preventative vaccination has become more common.

Erysipeloid is sometimes also found on poultry farms. Particular attention to the prevention of erysipeloid infections is also paid in turkey farms.

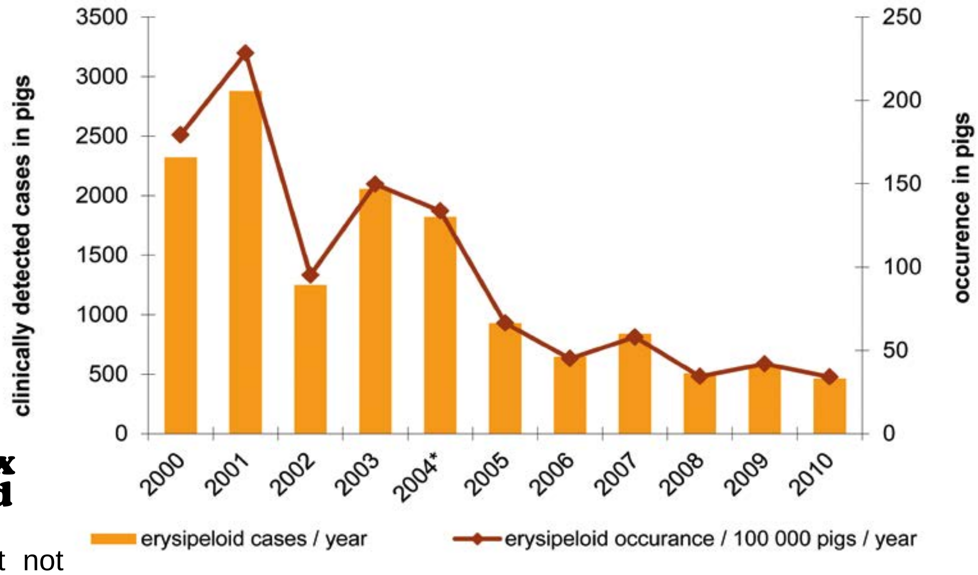


Figure: *Reported cases of erysipeloid on pig farms in 2000–2010 (*preventative vaccination became more common in 2004) (Source: Evira)*

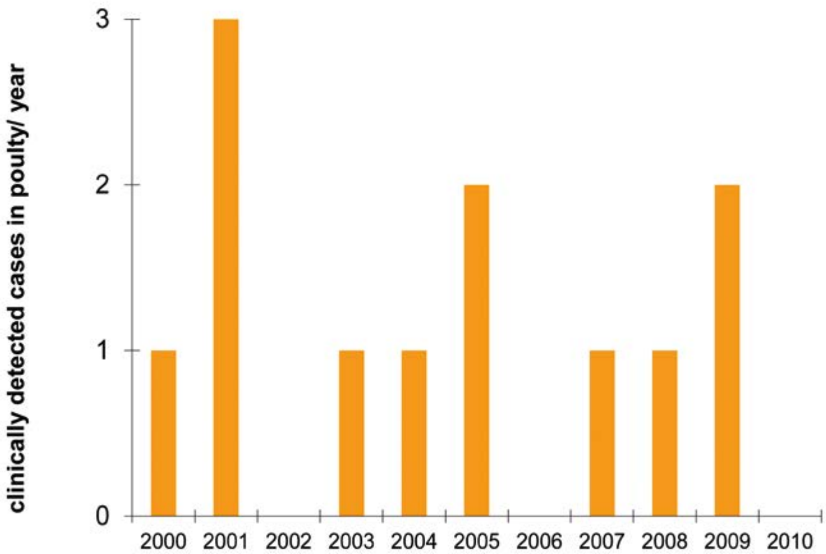


Figure: *Diagnosed cases of erysipeloid on poultry farms in 2000–2010 (Source: Evira)*

5.14. Yersiniosis

Yersiniosis is a disease caused by the bacterium *Yersinia*. The Yersinia are common intestinal bacteria in animals, and they are also found in the environment, such as the soil and natural waters.

5.14.1. Yersiniosis in humans

The key Yersinia species causing disease in humans are *Yersinia enterocolitica* and *Yersinia pseudotuberculosis*. The known forms of *Y. enterocolitica* are the pathogenic forms, which cause disease in humans, and harmless apathogenic forms. Yersinia is usually spread through contaminated food. Yersinia infections from one person to another are uncommon. The occurrence of Yersinia infections has remained more or less unchanged in the 2000s.

Yersinia enterocolitica

The number of *Y. enterocolitica* cases reported to the National Infectious Diseases Register remained at a relatively steady level in the 2000s. The majority of *Y. enterocolitica* findings in patients are harmless. Approximately less than 40% of the *Y. enterocolitica* findings in patients were estimated to be pathogenic. Between 2000 and 2010, two notable *Y. enterocolitica* food-borne outbreaks were reported.

Yersinia pseudotuberculosis

There was no clear trend in the occurrence of *Y. pseudotuberculosis* cases in the 2000s; the outbreaks caused a great fluctuation in the reported number of cases over the course of several years. A number of *Y. pseudotuberculosis* food-borne outbreaks were reported between 2000 and 2010.

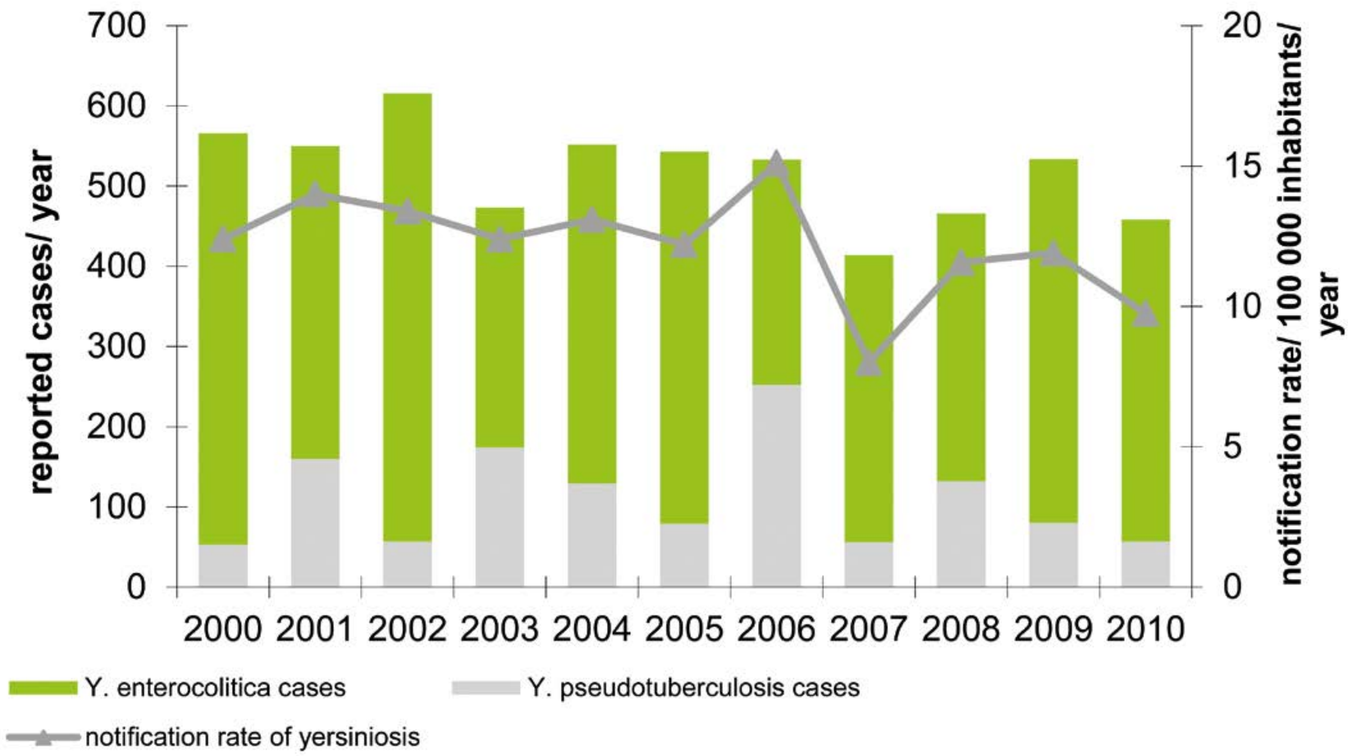
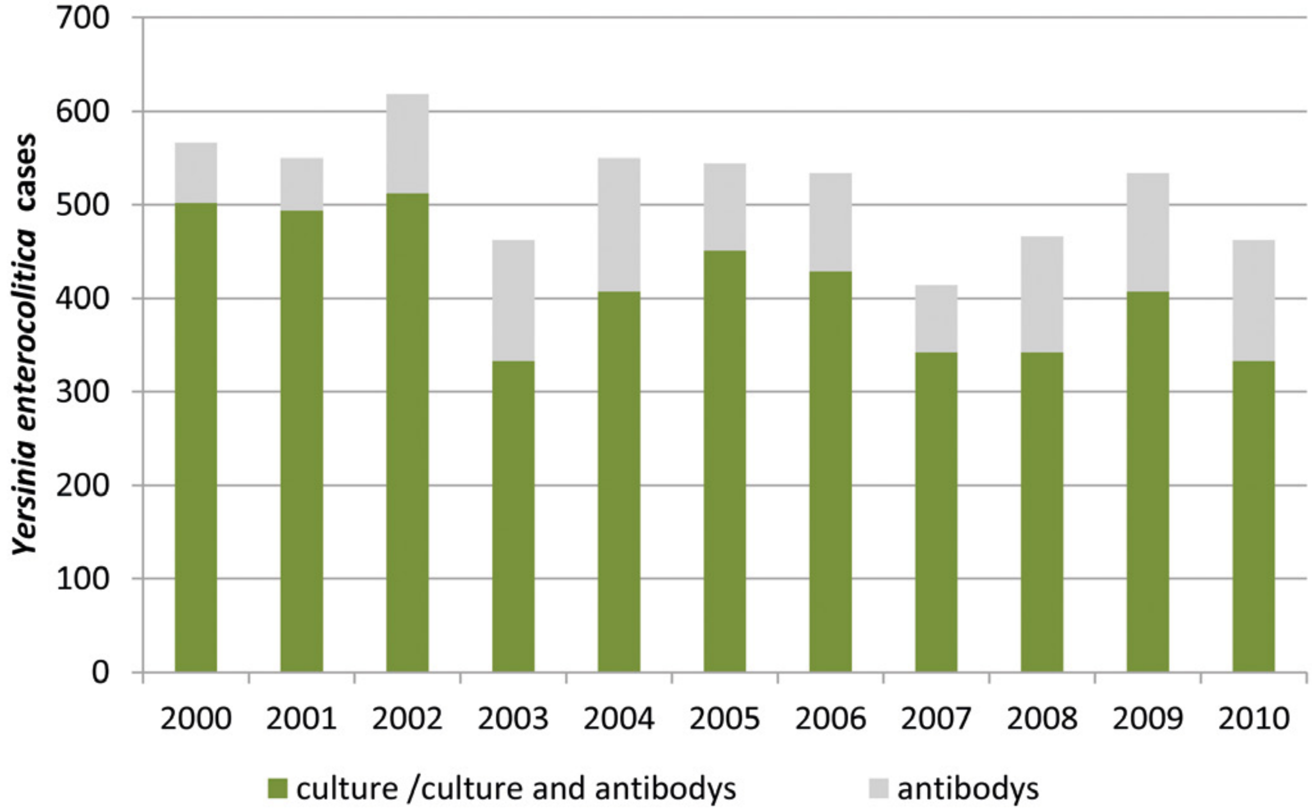


Figure: *Reported yersiniosis findings (culture and antibody findings) in 2000–2010 (Source: National Infectious Diseases Register, THL)*



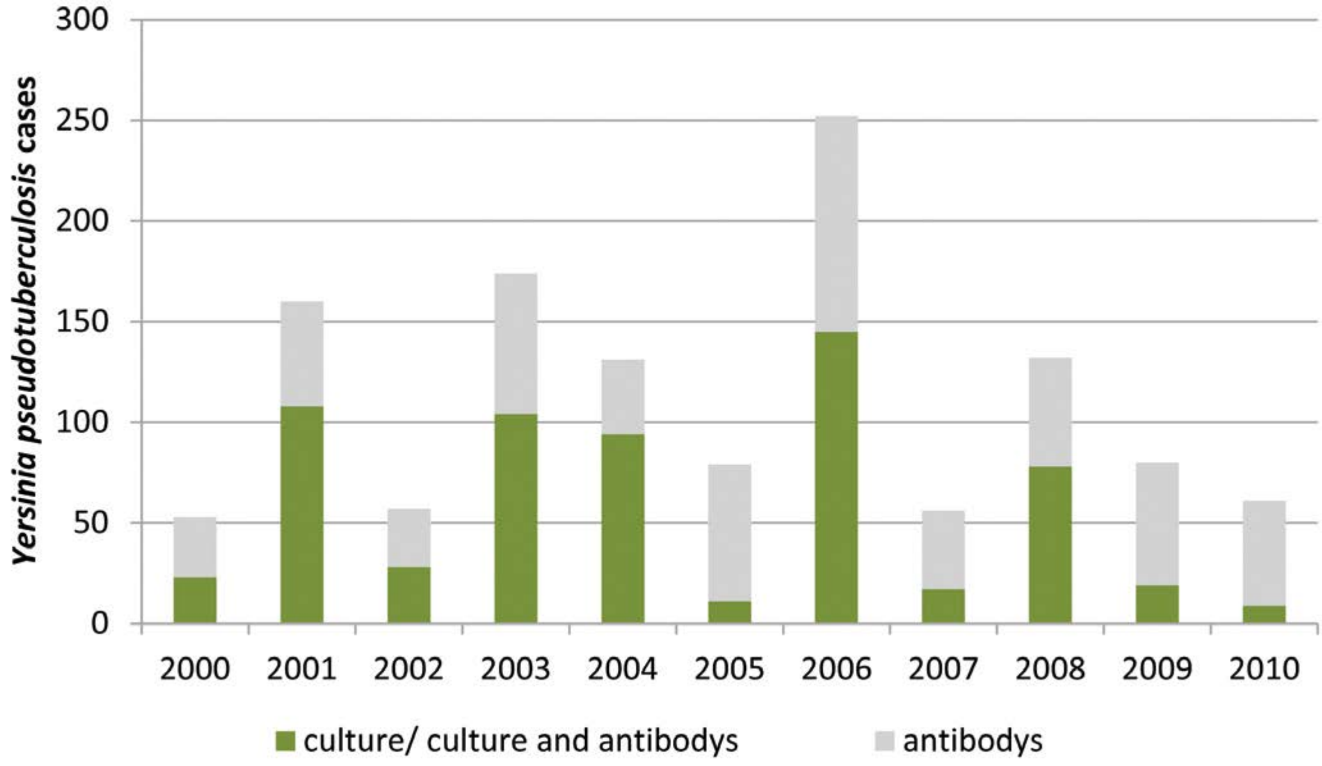


Figure a-b: *Yersinia findings reported to the National Infectious Diseases Register in 2000–2010 specified (a) Y. enterocolitica culture and antibody findings, (b) Y. pseudotuberculosis culture and antibody findings (Source: National Infectious Diseases Register, THL)*

5.14.2. Yersinia in food

Several mammal and fish species can carry Yersinia. Therefore, *Y. enterocolitica* can spread, for example, to meat during slaughter. Vegetables can be contaminated already during growing in the field through the soil, irrigation water or directly through animal faeces. As Yersinia also grows in the cold, it can multiply during the storage of vegetables.

The Yersinia species that are pathogenic to humans -*Y. enterocolitica* and *Y. pseudotuberculosis* - have been studied in food mainly as separate research projects and in connection with food-borne outbreaks.

Yersinia enterocolitica

According to a Finnish study on minced pork/beef and minced pork purchased from retail stores and published in 1999, the pathogenic *Y. enterocolitica* was found in 25% of the samples analysed with the PCR method and in 2% of the samples analysed with the cultivation method. In other related studies, no pathogenic strains of *Y. enterocolitica* have been found in meat of other animal species or in vacuum-packed fish on sale in Finland. *Y. enterocolitica* forms causing disease in humans have occasionally been found in vegetables grown in Finland. Vegetables have been suspected to be a possible cause of *Y. enterocolitica* infections and of food-borne outbreaks.

Yersinia pseudotuberculosis

Finnish vegetables (iceberg lettuce, Chinese cabbage and carrot) have repeatedly proven to be transmitters of *Y. pseudotuberculosis* epidemics. Since 2003, *Y. pseudotuberculosis* has caused several food-borne outbreaks transmitted by Finnish carrots. The long storage time of carrots from autumn until the next spring and even early summer enables bacterial growth to an extent that it can cause disease. In connection with the outbreaks, *Y. pseudotuberculosis* strains matching the cause of the disease has been isolated from unwashed carrots, contaminated liquid leaked from the carrots, carrot peel waste, and in samples of the surface cleanliness of storage and handling facilities.

Pathogenic *Y. pseudotuberculosis* was investigated with negative results from root vegetables,

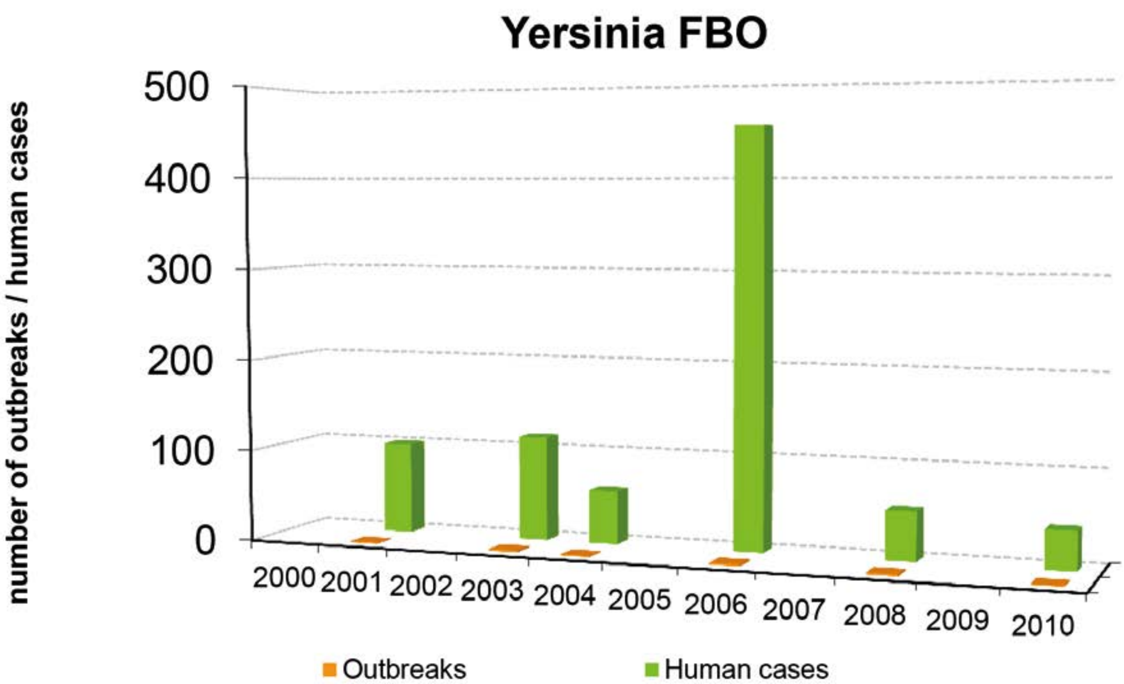


Figure: *Reported food-borne outbreaks caused by Yersinia in 2000–2010 (Y. entererocolitica outbreak in 2003 and 2010) (Source: Food-borne Outbreak Register, Evira)* such as carrots and other vegetable samples collected in vegetable farms, warehouses, processing facilities and retail stores in 2006.

5.14.3. Yersinia in animals

Wild animals, mainly small mammals and birds, are regarded as the reservoir of *Y. pseudotuberculosis.* Pigs are usually asymptomatic carriers of the bacterium *Y. enterocolitica.* Cats and dogs may also be asymptomatic carriers of the bacterium *Y. enterocolitica*. In animals, a Yersinia infection may cause diarrhoea or septicaemia, in rare cases abortions. However, the bacterium *Y. enterocolitica* is isolated very rarely in animal infections.

Domestic animals

In a Finnish study published in 2000, *Y. enterocolitica* pathogenic to humans was found in 37% of tonsil samples of pigs collected in slaughterhouses. In slaughterhouse studies carried out in 2006–2007, 33% of intestinal samples collected from pigs were found to have biotype 4 of the pathogenic *Y. enterocolitica* bacterium. The bacterium *Y. pseudotuberculosis* has also been found in pigs. For example, according to a study published in 2002, *Y. pseudotuberculosis* was found in 4% of pigs sent in Finland for slaughter.

In pets, Yersinia infection is considerably more uncommon. In a Finnish study published in 1997, *Y. enterocolitica* types causing disease in people were found in 2% of cat faeces and in 1% of dog faeces.

Wild animals

Y. pseudotuberculosis infections are found to some extent in wild animals in Finland, especially in hares and brown hares, as well as in birds. Of the hares analysed by Evira in 2000–2007, 3.7% were found to have a *Y. pseudotuberculosis* infection.

Wild animals may act as a source of *Y. pseudotuberculosis* in the wild. For example, in connection with the investigation of a food-borne outbreak related to carrots in 2004, *Y. pseudotuberculosis* strains of an identical type were isolated from patients and in the intestines of a shrew. The bacterium has also been found in small mammals caught in cultivation fields and investigated in connection with other food-borne outbreaks.

5.14.4. Significance of Yersinia in Finland

Yersinia bacteria are the third most common cause of intestinal infection in humans in Finland. Especially *Y. pseudotuberculosis* has caused several food-borne outbreaks transmitted by Finnish carrots. Finnish production animals may carry Yersinia, and wild animals also act as a source of Yersinia, especially for *Y. pseudotuberculosis*. The infection routes between animals and humans or those common to them are not known to a sufficient extent in order to be able to effectively prevent Yersinia infections.

Case report – examples of Yersinia pseudotuberculosis outbreaks related to carrots

In mid-May 2003, children with high fever and intense abdominal pains caught attention in the Central Hospital in the city of Kotka. All of the children who were sick, most of them attending school or day nursery, had eaten lunch prepared by the same central kitchen. An epidemiologic study was carried out on 77 cases, and in these the *Y. pseudotuberculosis* bacterium was either found in a stool culture (41 cases) or diagnosed as a sequel with erythema nodosum (35 cases) or reactive arthritis (1 case). The reference group was selected in random among all the 7,400 people who had been exposed. The source for the outbreak turned out to be grated carrot prepared from Finnish carrots, which had become contaminated already on the carrot production farm. Cases of the disease were also found in the city of Tampere where the central kitchen of schools had used carrots from the same farm. *Y. pseudotuberculosis* was diagnosed in 114 persons. The total number of people who contracted the disease was estimated to be about 840.

Y. pseudotuberculosis was also the reason for two food-borne outbreaks transmitted by stored carrots grown in Finland in 2006. A medium-sized epidemic took place in May–June in the area of the municipalities Nurmes and Valtimo, involving children and pupils who had attended day nursery or school. *Y. pseudotuberculosis* was found in stool samples of patients, and besides antibodies of *Y. pseudotuberculosis* were also found. Forty people suffered from symptoms complying with the case definition. The other, more extensive outbreak, caused illness in over 400 pupils and teachers at a school lunch in the municipality of Tuusula in late August. Carrots were suspected to transmit the epidemic and tracing of the source was started at once. The carrots had been bought from an Ostrobothnian farmer and then washed, peeled and delivered to the central kitchens from the peeling facility. The carrots had been harvested the previous year and stored on the farm of origin. *Y. pseudotuberculosis* was found in swab tests, soil tests and in the carrots found on the floor of the storage hall. The patient and environmental strains were identical in terms of their DNA profile. The storage facilities were cleaned and disinfected before the storage of new crops.

6. Diseases caused by viruses

6.1. Avian- and swine influenza

The influenza A virus, which is part of the *orthomyxoviridae* family, is found in humans and in several animal species, such as birds, pigs and horses. The influenza strains are specific to each species and are principally not transmitted from one species to another. There are several known subtypes of the A virus and they differ in terms of their pathogenic profiles. The classification of influenza A viruses into subtypes is based on two surface proteins, hemagglutinin (H) and neuraminidase (N). There are 16 known subtypes of the hemagglutinins and 9 subtypes of the neuraminidases of Influenza A virus, which are referred to with, e.g. the H5N1 subtyping of the virus.

According to current understanding, the genetic material of all influenza A viruses is present mainly in waterfowl that will keep the strains in the wild. Influenza A viruses can mutate. For example, pigs have receptors in their respiratory tract, and these receptors bind the A viruses of pigs, humans and birds. If a pig is simultaneously infected with the influenza viruses of humans or different animal species, this may create new influenza virus combinations. New virus mutations can also be created when the viruses of birds and humans are combined.

Influenza viruses are destroyed in normal cooking temperatures (over 70ºC).

6.1.1. Avian and swine influenza in humans

Avian influenza

An avian influenza virus of subtype H5N1, which originated from Asia, has infected not only birds, but also humans in several different countries. Since 2006, it has been mandatory to report cases of influenza H5N1 in humans to the National Infectious Diseases Register also in Finland. No cases have been found in Finland.

Swine influenza

Although influenza viruses are common in pigs throughout the world, there are descriptions of only individual cases where the swine influenza virus in pigs has spread to humans. The pandemic A (H1N1) influenza virus diagnosed in early 2009 contains influenza virus genes of pigs, birds and humans. Although genetically the virus has the closest resemblance to an influenza virus of pigs, it is not a swine influenza virus of pigs as such.

6.1.2. Avian and swine influenza in animals

Avian influenza

Avian influenza is an infectious disease of birds caused by the influenza A virus and found throughout the world. All birds are regarded to be susceptible to the disease, but some species are more resistant to infection than others. Influenza A viruses multiply in the bird's intestines and are secreted in large numbers into the faeces, from where they spread to other birds once they enter water. According to the clinical outcome in birds, the avian influenza virus types are divided into low-pathogenic and high-pathogenic types.

Since 2002, subtype H5N1 of the high-pathogenic avian influenza has spread from the endemic areas of South-East Asia to Europe and Africa, infecting both poultry and wild birds. An outbreak caused by the virus closest to Finland was diagnosed in waterfowl in Sweden in 2006.

The occurrence of avian influenza in poultry and wild birds has been monitored every year since 2003. In these studies, no high-pathogenic avian influenza A viruses have been found in Finland.

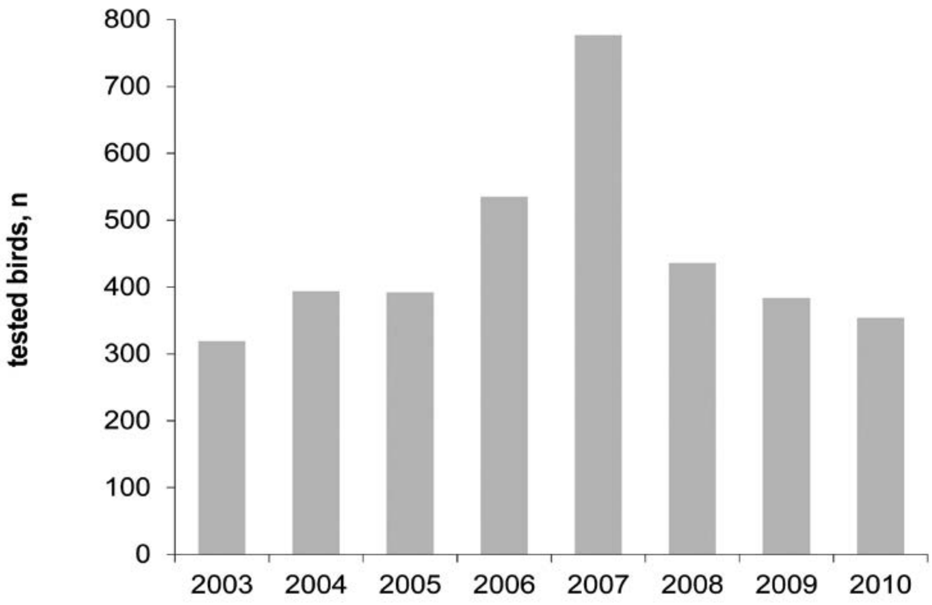
Swine influenza

Swine influenza is a respiratory tract disease in pigs caused by the influenza A virus. Swine influenza was described as a disease of pigs for the first time in the United States in the early 1900s. Currently, swine influenza is found in North and South America, as well as in most countries in Europe and Asia.

In pigs, the disease was diagnosed for the first time in Finland in 2009. The virus type is H1N1 and it resembles virus strains isolated from European pigs. In 2009, about 30% of farms that sent pigs for slaughter seemed to have antibodies to swine influenza. However, there is no detailed information about the prevalence of the disease in Finland.

Pandemic A (H1N1) 2009 influenza virus

The pandemic A(H1N1) influenza virus, which spread during 2009 causing disease in humans, has also been found throughout the world in different animal species, such as pigs, turkeys and ferrets. In animals, the symptoms caused by the virus have mainly been mild. In cases where it has been possible to trace the source of infection, a human has been found to be the source of infection. The virus has been found in pigs in Finland.



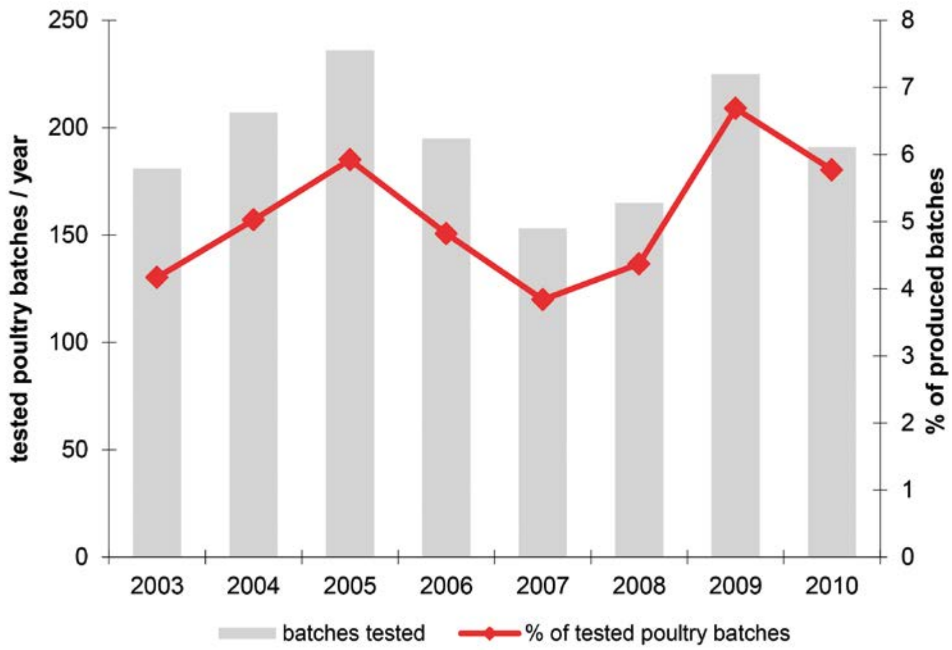


Figure a-b: *Avian influenza investigations on (a) wild birds (b) poultry in 2003–2010 (Source: EU surveillance programme, Evira)*

6.2. Epidemic nephropathy

Epidemic nephropathy is a haemorrhagic fever with renal symptoms, caused by the Puumala virus. Humans are usually infected through dust contaminated with the secretions of bank voles. The cases of the disease have been reported to follow the variations in the vole population so that the number of cases is highest when the number of voles is up or at its peak.

6.2.1. Epidemic nephropathy in humans

From 774 to 2,603 cases have been reported to the National Infectious Diseases Register each year. The number of diagnosed cases varies to a great extent annually, according to the variation in the vole population. It is estimated that about 5% of the Finnish population have antibodies against the virus causing epidemic nephropathy.

6.2.2. Epidemic nephropathy in animals

In the wild, bank voles act as the source and asymptomatic carriers of the virus. The disease has not been found in domestic animals, but the communicability of the virus to domestic animals has not been studied to a sufficient extent.

The occurrence of the virus in the Finnish bank vole population was studied more extensively in the early 1980s, and it was found that about 20–30% of the voles carried the virus. In certain years, up to 80% of the population were carriers. The occurrence of the virus in the bank vole population seems to vary according to the changes in the number of voles, which follows a 3–4-year cycle.

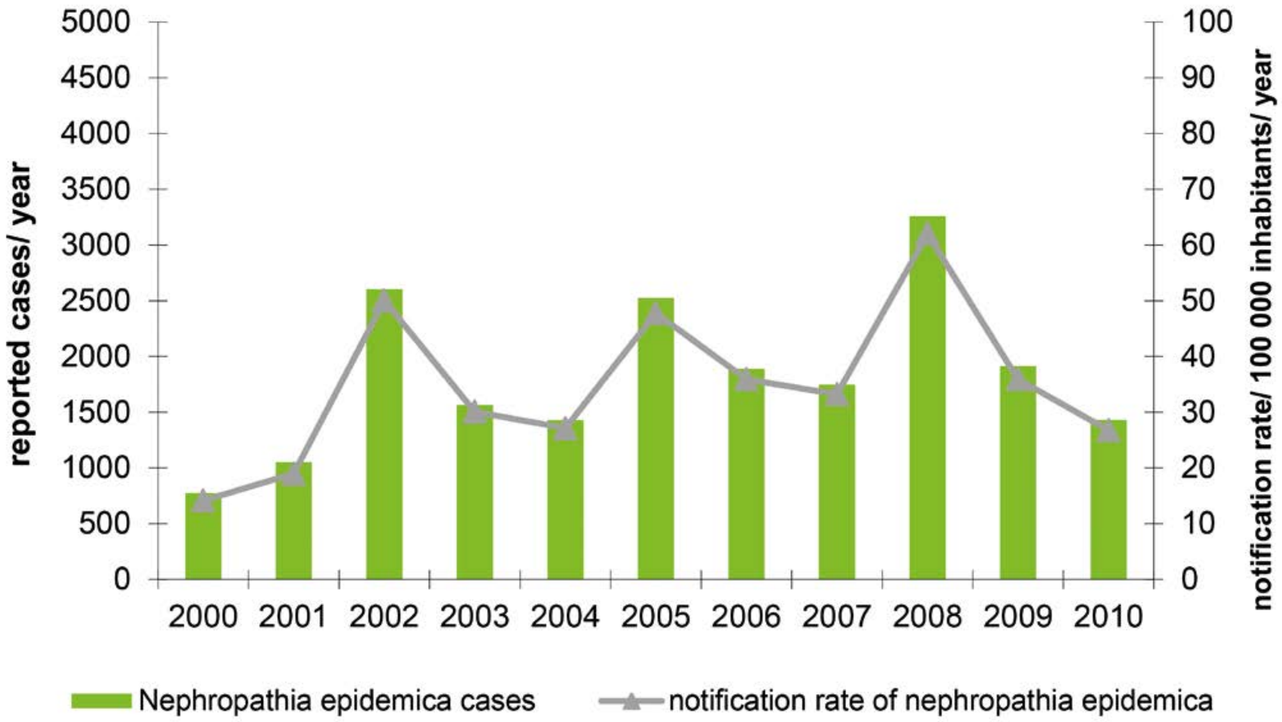


Figure: *Cases of epidemic nephropathy reported to the National Infectious Diseases Register in 2000–2010 ((Source: THL)*

6.3. Rabies

Rabies is a disease of the central nervous system and the virus causing it is a type species of the Lyssavirus genus in the family of Rhabdoviridae.

6.3.1. Rabies in humans

A rabies infection in humans is usually transmitted through a bite from an infected animal or contamination of a skin cut or mucous membrane with animal saliva. Rabies from bats can also be transmitted through the respiratory tract in bat caves, but the infection is usually related to the handling of bats. The disease results in death within a few days of the onset of symptoms. Treatment administered immediately after an exposure prevents the disease from developing. People who handle bats are vaccinated against rabies as a preventive measure.

The latest endemic rabies infection confirmed in Finland was in the 1930s. In the 1910s–1930s, infections in humans were the result of a dog bite. One person has died from bat rabies in Finland in 1985. The person had been in close contact with bats.

The latest rabies case was registered in September 2007 when a Philippine man travelling in Finland died of rabies as a result of infection, which he probably caught in his home country.

In the 2000s, the National Infectious Diseases Register received doctors' notifications of 14–72 people who had received rabies treatment after exposure each year. The majority of the exposures had taken place abroad, and the most common reason for exposure was a dog bite.

6.3.2. Rabies in animals

All mammals can be infected and transmit the infection further to other mammals and also to humans. The incubation period from infection to rabies varies in animals from a few days to several months. An infected animal can transmit the infection already a few days before the onset of symptoms. After the onset of symptoms, rabies will be fatal within two weeks.

Domestic animals

A rabies infection in domestic animals is usually the result of a bite from an infected animal. In Europe, the most significant animals in terms of the spread of rabies are dogs, cats, foxes and raccoon dogs. Rabies is present in the nearby areas of Finland in the Baltic countries and in Russia.

To combat the disease, for example, hunting dogs and working dogs used by the authorities are obligated to be vaccinated. Rabies vaccination of other dogs and cats is also recommended. In order to prevent rabies from entering the country, animal imports are subject to special vaccination and inspection requirements.

Between 1910 and 1959, a total of 2,300 cases of animal rabies were found in Finland. During 1988–1989, there was a rabies outbreak in domestic and wild animals in Finland, in connection with 66 cases of animal rabies infections were diagnosed. The epidemic was brought under control with vaccination campaigns. After that, no rabies infections obtained in Finland have been found.

In order to prevent a new spread of rabies, a vaccination programme on wild animals has been implemented since 1988. In the programme, vaccine baits meant for small predators have been distributed from the air along the south-eastern border of Finland, at first once a year and since 2003 twice a year. The success of the vaccination programme is monitored constantly by examining the antibody levels from the blood samples of predators that have been found or hunted in the vaccination zone. The results have been good.

In order to monitor the rabies situation and to detect any infections, a few hundred domestic and wild animals are examined each year.

Bats

In relation to a human case, rabies in bats was suspected for the first time in Finland in 1985. Due to the case, first an epidemiological study in 1986 and thereafter subsequent rabies surveillance in bats were launched. Rabies in bats has been detected once in 2009, when the European Bat Lyssavirus 2 (EBLV-2) was confirmed in a Daubenton's bat.

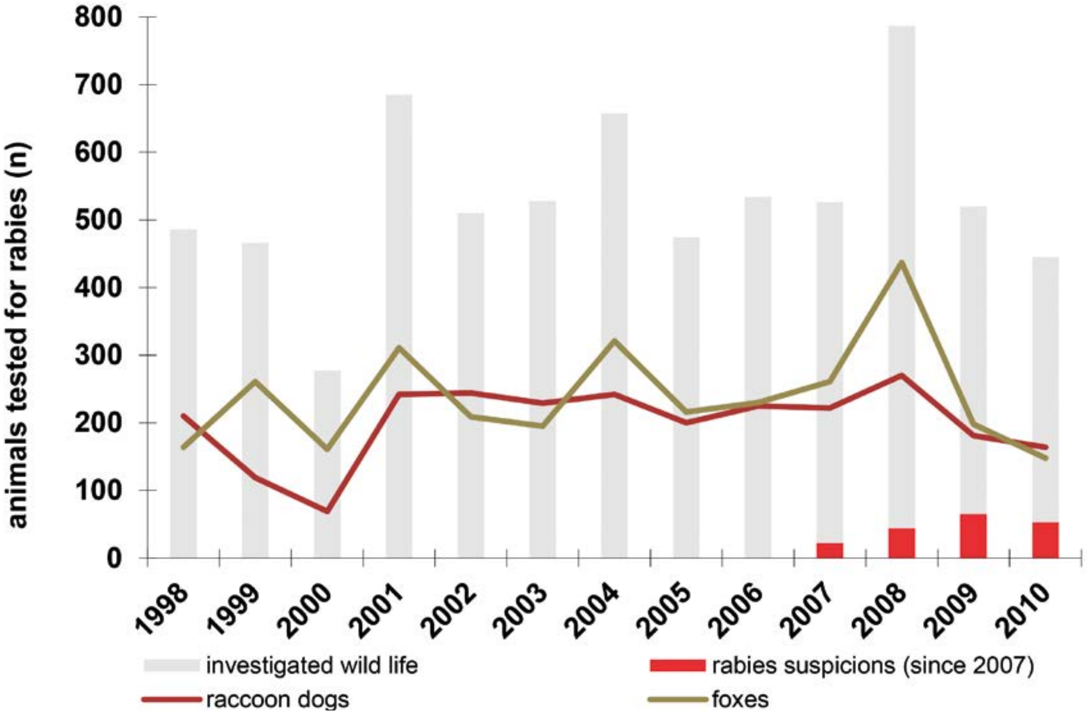


Figure: *Total number of rabies investigations of wild animals and suspected cases. The number of raccoon dogs and foxes examined specified separately (Source: Evira)*

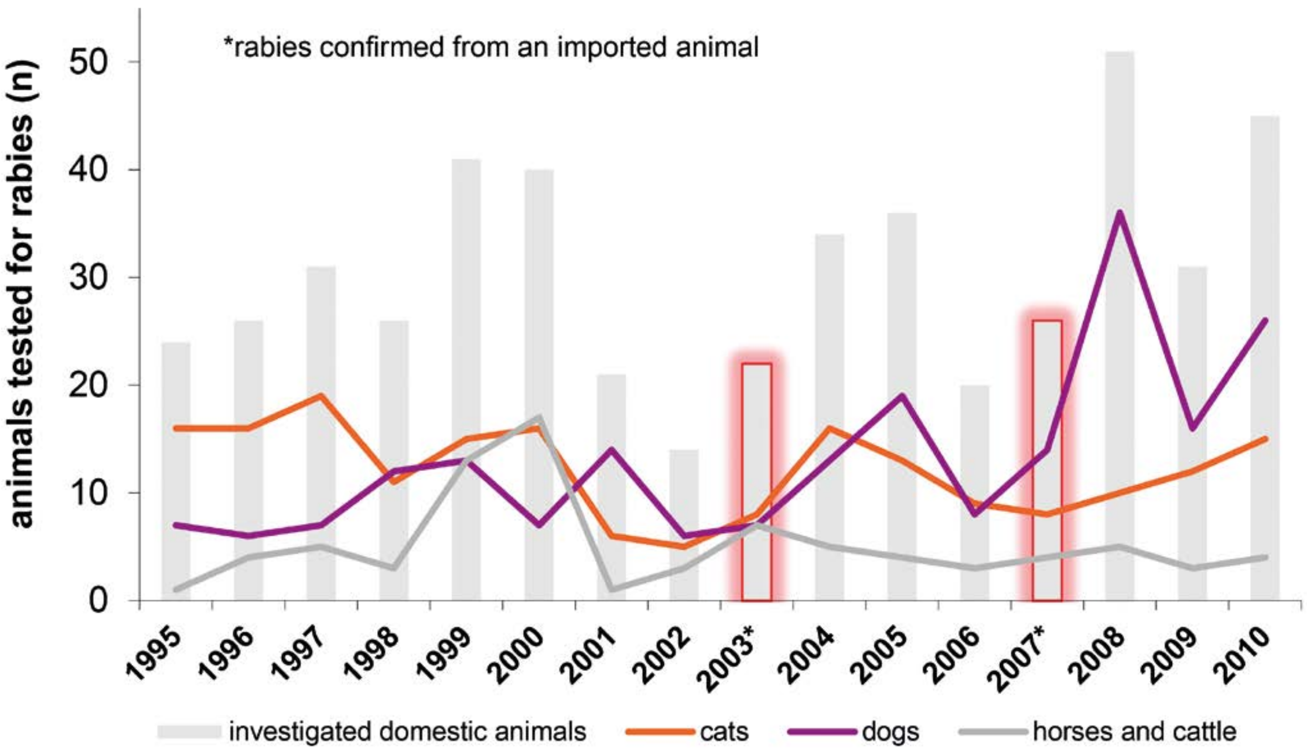


Figure: *Rabies investigations of domestic animals, specified for the investigation of cats, dogs, horses and cattle (Source: Evira)*

Case reports – rabies in a horse and a puppy imported to Finland

In summer 2003, a gelding that had been imported to Finland from Estonia about one month before started to show neurological symptoms. The owner called a vet to examine the horse after it had fallen while standing up and then having been shaky and atactic. When being examined, the horse was trembling, it was sensitive to touch and it kept staggering. The horse was tender to palpation of the muscles of the cervical spine and neck. When bending the neck, it staggered and almost fell over. It seemed listless and sluggish. Its cheek muscles and lips were swollen and tense, and it was biting its teeth together. Throughout the examination, the horse regarded the vet in a friendly manner although it was obvious that, for example, touching and bending its neck was painful. The horse tried to eat, but it kept turning the hay around in its mouth in a thick tuft. The horse's temperature was up (+39.7 ºC). When the vet was giving the horse an intravenous injection, it suddenly flared up without warning and bit the vet on the hand, and tried to kick and bite him again. After that, the horse was friendly again and came to have a sniff at the vet with ears pricked up. By the next morning, the horse seemed better, but it deteriorated in the afternoon and was put down, and its head was delivered to the National Veterinary and Food Research Institute for rabies tests. The tests revealed that the horse had had rabies. The vet and the other people who had been in close contact with the horse were given a series of rabies vaccinations. The horses that had been in contact with the horse were put in quarantine for 6 months and were vaccinated against rabies.

Rabies was diagnosed in a puppy brought to Finland from India in early November 2007. The puppy came to Finland with its owner and the customs officials had inspected the puppy's documents. The authorities heard about the case after members of the owner's family contacted the municipal veterinarian and it turned out that the dog did not meet the requirements set for animal imports. In India, a few days before the journey to Finland, the puppy had been seen by a vet who had found it healthy and vaccinated it against rabies. The required antibody tests had not been carried out.

The puppy was estimated to be only six weeks old when it arrived in Finland. Negotiations on putting down the puppy or returning it to the country of origin were carried out with the person who brought it into the country. At the same time, the quarantine of the puppy was made more difficult by the fact that the person who brought it into the country was unable to find an appropriate place of quarantine for the puppy. When searching for a place of quarantine, the puppy had been transported through several locations in Southern Finland. The puppy was put down after it had been in Finland for five days once the municipal veterinarian found it to be in poor condition. The puppy was feverish and apathetic. It was sent for autopsy to Evira where it was found to have a jaw fracture, osteomyelitis and encephalitis. Rabies was confirmed in virological examinations.

When investigating the case further it was revealed that the puppy originally came from a litter that was probably born on the street and whose mother was a stray bitch. While on the street, the puppies were exposed to attacks by loose dogs, and a stray dog had been seen attacking the puppies at the end of October, leaving some of them with bite marks. The puppies had been rescued from the street; one of them was adopted as a pet in India and one was brought to Finland. All of the people who were exposed in Finland were advised to receive appropriate post-exposure treatment. None of them contracted rabies.

6.4. Tick-borne encephalitis (TBE)

Tick-borne encephalitis (TBE) is caused by the arbovirus, which is also known as the Kumlinge virus. The virus is carried by ticks.

6.4.1. TBE in humans

Tick-borne encephalitis, which mainly spreads through ticks, is found in Finland especially in the Åland Islands and the Turku archipelago. Infections have also been diagnosed in the Kokkola and Lappeenranta regions. At the end of the decade, new potential areas of infection were also discovered in Eastern and Northern Finland. The majority of cases are diagnosed between July and September, but cases have also been detected from May all the way to November.

In the early 2000s, there were 30–40 cases diagnosed each year, about 70% of them in the Åland Islands. In the middle of the decade the number of cases fell to 15–20, but started to rise again. The number of cases has been affected by the vaccination campaign carried out in the Åland Islands. In the past few years, only just under a third of cases have been found in the Åland Islands.

6.4.2. Kumlinge virus in food

Unpasteurised milk, especially goat's milk, can act as the source of a Kumlinge virus infection. In Finland, this kind of infection was once suspected, with unpasteurised goat's milk being suspected as the source of infection.

6.4.3. TBE in animals

The reservoirs of the arbovirus in the wild are mainly small rodents from which infection is transmitted to ticks. It is estimated that about 2% of small rodents may be carrying the virus.

The virus can be transmitted to several animal species through ticks or mosquitoes. As a result of the virus infection, arbovirus can be secreted, e.g. into goat's or sheep's milk. In animals, the virus usually only causes an asymptomatic infection. However, dogs have been reported to have e.g. symptoms of the central nervous system resulting in death. In Finland, there have never been cases of the disease diagnosed in animals. According to studies carried out in Finland, some dogs and horses have arbovirus antibodies.

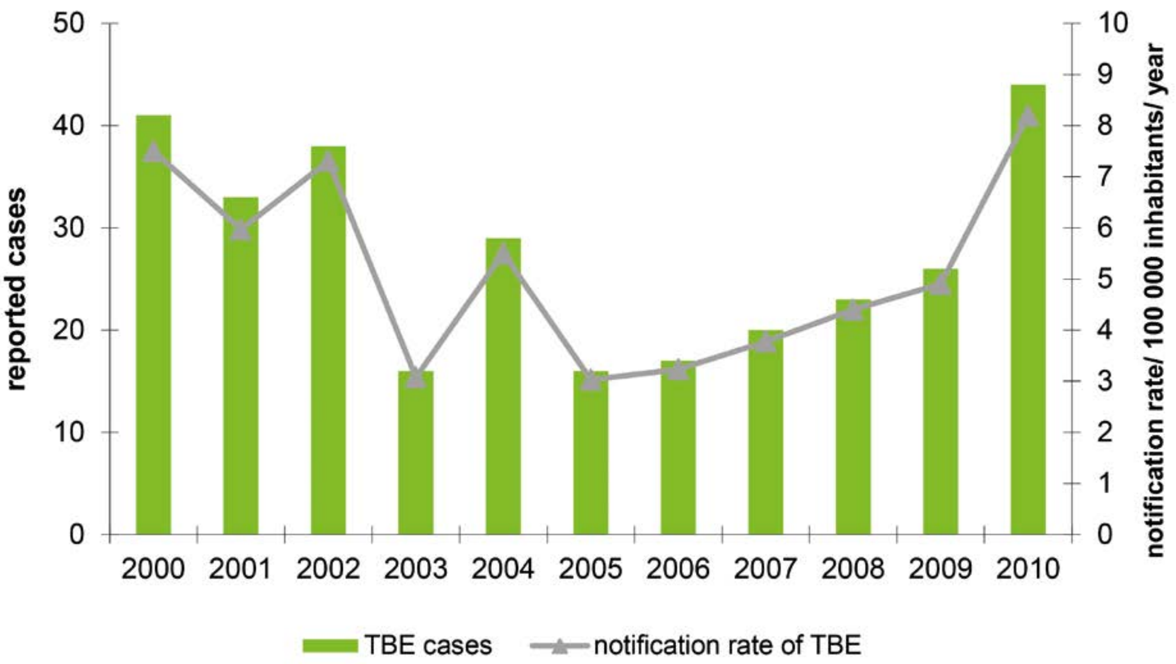


Figure: *Cases of tick-borne encephalitis reported to the National Infectious Diseases Register in 2000–2010 (Source: THL)*

7. Diseases caused by parasites

7.1 Echinococcosis

Echinococcosis is a disease caused by the parasitic worm *Echinococcus granulosus* or *Echinococcus multilocularis*. *E. granulosus* and *E. multilocularis* are parasites of carnivores and part of the tapeworm family. The life cycle of tapeworms include an adult stage of the worm in the definitive host and the larval stage in the intermediate host. Adult Echinococcus worms live in the small intestines of carnivores. The eggs of the worm spread into the environment through the faeces of the definitive host and that way to the intermediate host. In the intermediate host, the larval stages of the parasite multiply asexually, forming fluid-filled cystic formations, hydatid cysts, in the internal organs. Usually the cysts are present in the liver and the lungs. The life cycle of the parasite ends when the definitive host eats organs containing parasitic cysts.

7.1.1. Echinococcosis in humans

A human can act as an aberrant intermediate host to both *E. granulosus* and *E. multilocularis* tapeworm species. A human can be infected, for example, through the faeces of a dog, fox or wolf or water contaminated by them, or from the eggs of a tapeworm attached to a dog's fur. It is also possible, for a human to be infected through berries or mushrooms contaminated by the faeces of a dog or wolf carrying the parasite, but this is fairly unlikely as humans are not particularly susceptible to the infection of the parasite. In humans, the larvae form fluid-filled cysts, so-called hydatid cysts, in the tissue.

In the 2000s, *E. granulosus* infections were reported to the National Infectious Diseases Register sporadically. Prior to that, only one case was reported to the register in 1998. The reported infections were contracted abroad. *E. multilocularis* infection has not been reported in humans in Finland.

7.1.2. Echinococcosis in animals

Adult *Echinococcus* parasites live in the small intestine of its definitive host. The infection does not cause symptoms in the host animal. Definitive hosts include many carnivores, such as dogs, wolves and foxes.

Other domestic animals, such as cattle, sheep, pigs, reindeer and horses, may have parasitic cysts containing *E. granulosus* larvae. During

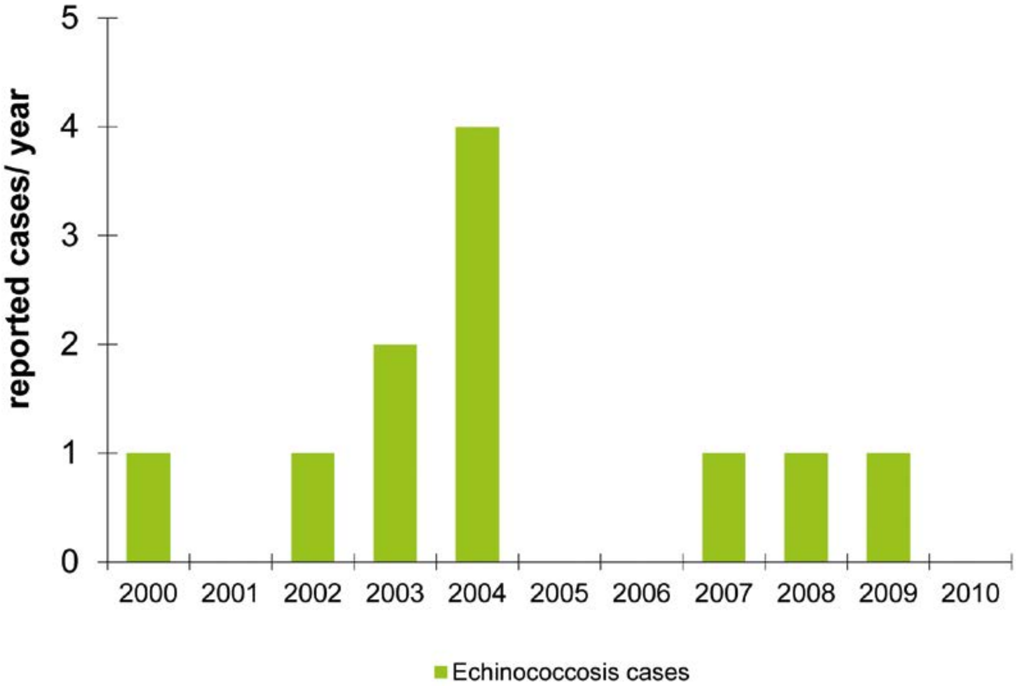


Figure: *Echinococcus granulosus infections reported to the National Infectious Diseases Register in 2000–2010 (Source: THL)* meat inspections, parts of carcass and organs where parasitic cysts are detected will be rejected and destroyed.

Intermediate hosts of the *E. granulosus* genotype (G10) present in Finland include elks and reindeer, due to which the parasite is called Fennoscandian cervid strain, or “elk echinococcus”. According to the same principle, the *E. multilocularis* species is called ”vole echinococcus” because voles are its intermediate hosts. So far, the *E. multilocularis* parasite has not been diagnosed in Finland, but it is known to be present in, e.g. Estonia and Sweden.

In order to prevent the spread of echinococcosis, it is important that all cystic formations of internal organs are examined, especially during the meat inspection of game, and destroyed so that they will not be eaten by carnivores. Furthermore, dogs should be given regular tapeworm treatment especially in reindeer management areas. Hounds should be treated before and after the hunting season. Dogs entering Finland are expected to have been treated against tapeworm before entering the country especially in order to prevent the spread of the *E. multilocularis* parasite.

Domestic animals

E. granulosus infections of domestic animals are uncommon in Finland. The majority of infections in reindeer are diagnosed close to the eastern border in the municipalities of Salla and Kuusamo. The parasite has been found in elk lungs in Kainuu and North Karelia.

In the 2000s, in connection with meat inspections and separate monitoring projects, the *E. granulosus* parasite, or elk echinococcus infection, was mainly found in reindeer and elks. The number of detected infections fell during the 2000s. Sometimes, *E. granulosus* genotype 4 infections have also been found in imported horses.

Wild animals

The occurrence of echinococcus infections in wolves, foxes and raccoon dogs is studied each year. Of the few dozens of wolves studied each year, a maximum of two (0–2/year) have been found to have the *E. granulosus* parasite, or an elk echinococcus infection. No *E. multilocularis* parasite, or the vole echinococcus infection, has been found in the 400–500 foxes and raccoon dogs inspected each year in Finland.

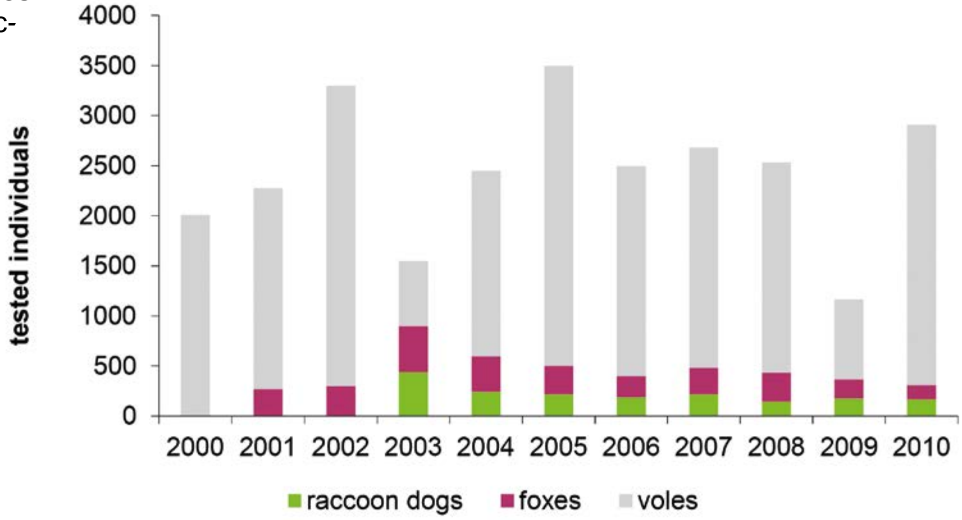


Figure: *Echinococcocus monitoring in wildlife in 2000–2010 (Source: Evira)*

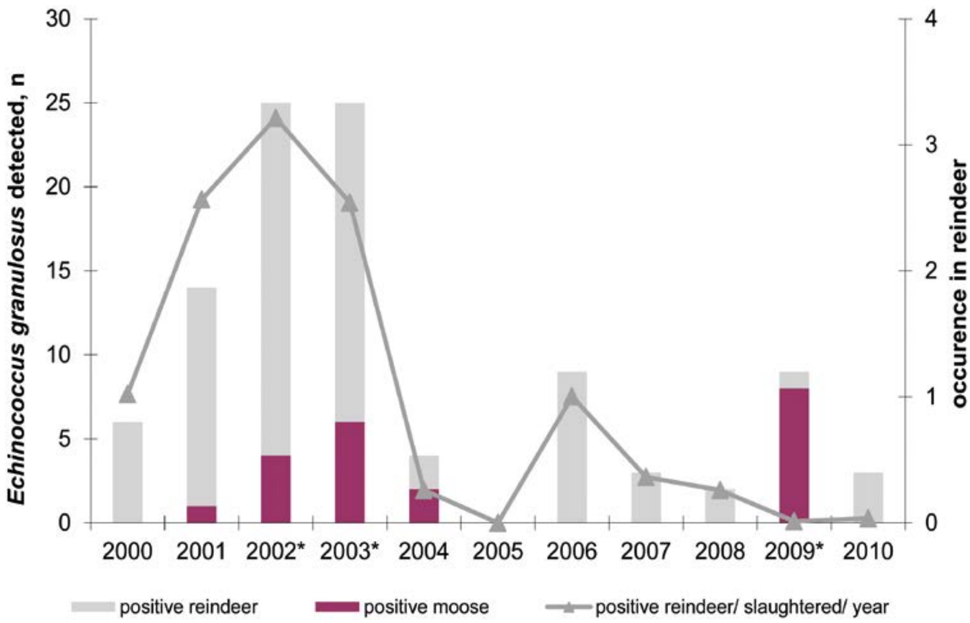


Figure: *E. granulosus infections in reindeer and elk (=wild moose), diagnosed in connection with meat inspections and separate monitoring projects in 2000–2010 (Source: Evira)*

7.2. Cryptosporidiosis

Cryptosporidiosis is a disease caused by the *Cryptosporidium protozoon* belonging to the coccidians. Zoonotically the most significant species is *C. parvum*. The cryptosporidia have a direct life cycle and the form excreted in the faeces (oocyst) is highly resistant in external conditions.

7.2.1. Cryptosporidiosis in humans

Humans are infected with *Cryptosporidium* through faeces either in direct contact with another human or an animal excreting oocysts or through food, swimming water or drinking water contaminated with the animal or human faeces. Cryptosporidiosis usually causes self-limiting diarrhoea in humans. The infection can also be asymptomatic. In the immune deficient, the clinical profile may be serious.

In the 2000s, 4–18 cases of cryptosporidiosis were reported to the National Infectious Diseases Register each year. The low number of cases is probably due to the low number of tested individuals. In 2009 and 2010, work related cryptosporidiosis cases in people taking care of calves were reported.

7.2.2. Cryptosporidia in food

Food or drinking water contaminated with faeces may act as a source of cryptosporidiosis. Salad is suspected to have transmitted a *C. parvum* protozoon food-borne outbreak in 2008.

7.2.3. Cryptosporidiosis in animals

Several animals can excrete in their faeces *Cryptosporidium* species causing infection to humans. Cryptosporidia have been found in several different animal species from mammals to birds and fish. The *C. parvum* species, which is the most important one with respect to its pathogenic properties, is found in many animal species, especially in ruminants.

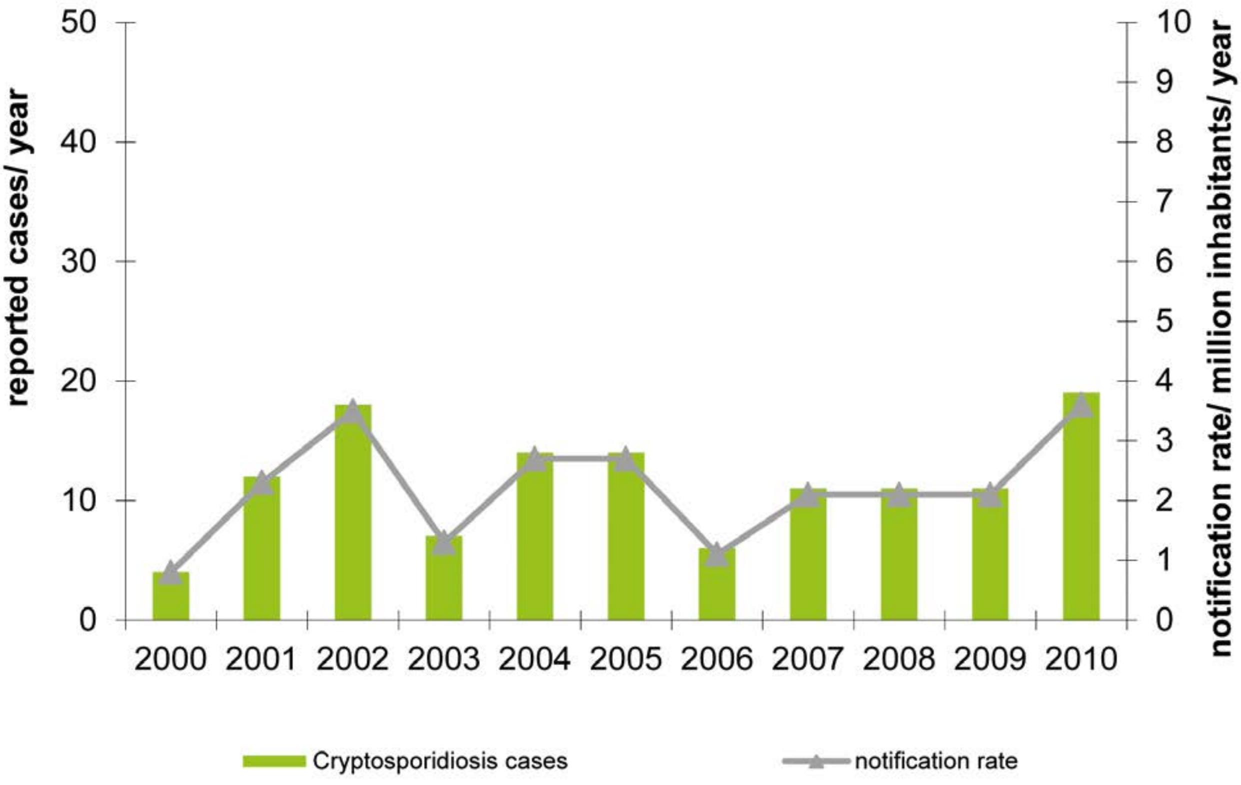


Figure: *Cryptosporidiosis cases reported to the National Infectious Diseases Register in 2000–2010 (Source: THL)*

Asymptomatic infection is common in animals. Clinically sick animals are usually young ones. The principal symptom is diarrhoea, which is usually self-limiting. The *C. parvum* species that is contracted by humans from cattle usually occurs in calves under the age of two months.

In Finland, cryptosporidia are examined from animal faeces samples. For example, all diarrhoea samples of calves under the age of two months that are sent to Evira for examination are tested for cryptosporidia. Cryptosporidia have been found regularly in the faeces samples of both calves and sheep. Although the occurrence of cryptosporidium is common, the majority of the confirmed species do not cause disease in humans or animals. Only a few samples each year contain *C. parvum* that causes disease in humans. The findings are mainly from individual cattle farms. However, the number of *C. parvum* findings slightly increased in 2009 and 2010 compared to previous years.

In 2010, faecal samples of calves with diarrhoea representing more than 200 farms were investigated. The protozoan *C. parvum* was detected in samples of 12 different farms.

Cryptosporidia have also occasionally been found in faeces samples of reindeer, pigs and cats, as well as those of pet reptiles.

Case report – Cryptosporidum protozoa was found to cause a food-borne outbreak for the first time in Finland

In October–November 2008, 72 people contracted diarrhoea caused by the *C. parvum* protozoa over a couple of weeks in Helsinki. Those who fell ill had dined at the same staff canteen. In addition to watery diarrhoea that lasted an average of one week, the patients also experienced strong stomach pains, tiredness and nausea. Of the 12 faeces samples tested, four were found to contain *C. parvum*. The source of infection was investigated with questionnaire studies and extensive tracing measures. The fairly extensive cohort study did not reveal the vehicle of the infection. Afterwards, it was discovered that some of the salads that were also served were not included in the list of foods given on the original questionnaire, and therefore a smaller case control study was carried out at a later date. This study confirmed the suspicion of the connection between an overseas salad mix and the infection. In addition to other food studies, the suspected salad, although a different batch, was tested for *C. parvum*, but the test results were negative. The food examination was carried out using the same method as in the examination of faeces. More rigorous tracing of the salad proved to be impossible: the salad had been imported to Finland in a consignment of about 500 kg, consisting of two different batches with salads from five different European countries.

7.3. Toxoplasmosis

Toxoplasmosis is an infectious disease caused by the parasite *Toxoplasma gondii*. *T. gondii* is a unicellular protozoon, which multiplies in the cells of the mucous membranes in the intestines of felines, which act as the primary host. Intermediate hosts may include humans, domestic and wild mammals, and birds. Toxoplasma has two different life cycles: sexual reproduction taking place in the intestines of felines and asexual reproduction taking place in the intermediate hosts. Toxoplasma can also survive without felines.

7.3.1. Toxoplasmosis in humans

Humans can be infected with *Toxoplasma* either directly from the faeces of a cat excreting oocysts or through vegetables or soil contaminated with cat faeces. It is also possible to get an infection by eating undercooked meat that contains tissue cysts. A toxoplasmosis infection is common in humans, although the clinical disease itself is more uncommon. During pregnancy, *Toxoplasma* may pass through the placenta, causing congenital toxoplasmosis in the child.

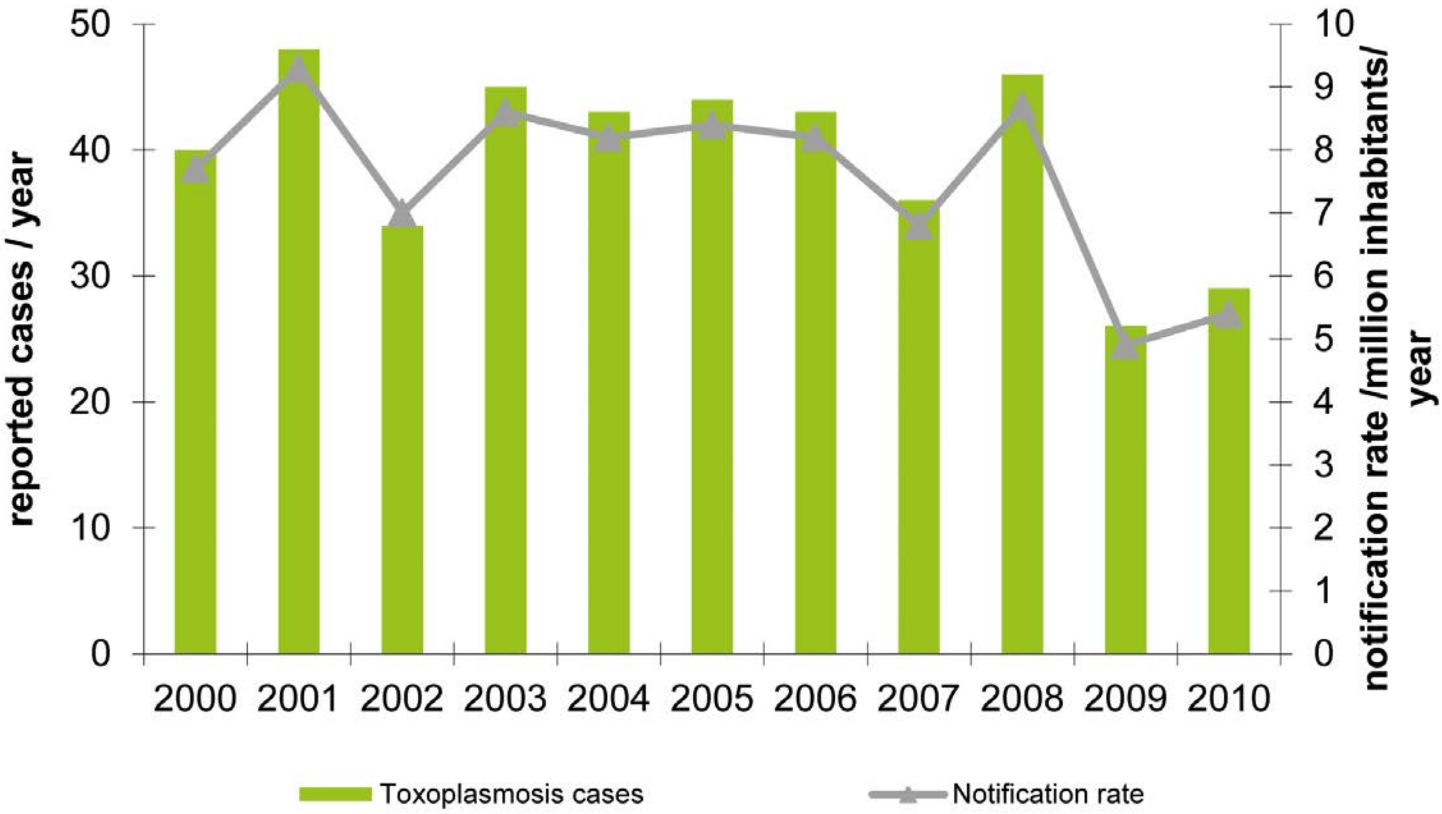


Figure: *Toxoplasmosis cases reported to the National Infectious Diseases Register in 2000–2010 (Source: THL)*

In the 2000s, 34–48 *Toxoplasma* infections were reported to the National Infectious Diseases Register each year: 66% of the infections were in women, 45% of whom were aged between 15 and 44. It is estimated that about 50 children are born with congenital *Toxoplasma* infection each year.

7.3.2. Toxoplasma in food

Undercooked meat may contain tissue cysts of the *Toxoplasma* parasite. Contaminated with a cat's faeces, *Toxoplasma* cysts may end up in, e.g. vegetables. Encapsulated parasites are destroyed when heating (+65° C) or freezing. The occurrence of *Toxoplasma* in food has not been studied in Finland.

7.3.3. Toxoplasmosis in animals

In the wild, a cat is usually infected after eating a small rodent or a bird that had encapsulated parasites in its tissues. A cat can also be infected from the faeces of another cat or from uncooked meat. As a result of sexual reproduction taking place in the cat's intestines, so-called oocysts are excreted in the faeces. A cat excretes oocysts only for a short time after being infected, but *Toxoplasma* may survive in its tissues for the rest of its life. It will take 1–5 days for oocysts to start sporulate and become infective in the environment, due to which it is recommended that cats' litter boxes are changed every day. A cat can pass the infection to its offspring either through the placenta or milk. In a kitten, the infection may result in a serious general infection and death.

After being infected, other animals do not excrete *Toxoplasma* oocysts, but the parasites are encapsulated in their tissues. Therefore, carnivores are usually infected when eating meat or organs that contain encapsulated parasites. In vegetarians, the most significant sources of infection are oocysts in the environment. Finnish lagomorphs (excluding the city rabbit) are very susceptible to this parasite, and infection usually results in death. Infection in other animals is usually asymptomatic.

Parasites encapsulated in tissue may survive for a long time, remaining infectious even after the death of the animal.

Dozens of animals that have died of a sudden general infection caused by *Toxoplasma* are received by Evira for examination each year. Fatal infections have mainly been found in hares and cats, and of the zoo animals in kangaroos.

Occurrence of the *Toxoplasma gondii* antibodies in Finland has been studied in sheep and game. Of the sheep over one year of age studied in 2008, 25% had *Toxoplasma* antibodies while 76% of the examined sheep flocks tested positive for antibodies. The occurrence of antibodies seems to be more common in Southern than in Northern Finland. *T. gondii* has been detected in sheep in connection to abortion. Antibodies have also been found in elk and white-tailed deer. Previously, it has been discovered that the infection is fairly common among reindeer that are fed in enclosures, but always very rare in those grazing in natural pastures.

7.4. Trichinellosis

Trichinellosis is caused by the nematode larvae of the genus *Trichinella*. The trichinella parasites occur in carnivorous mammals and they are present almost everywhere in the world. An animal or human infected with trichinella carries infectious larvae in its muscles for years after being infected. In the wild, trichinella spreads when carnivorous animals catch each other or eat carcasses. The trichinella larvae mature in the intestines of the host animal. The larvae produced by the adult forms travel from the intestines to various parts of the organism through blood, primarily to the striated muscles, but sometimes also, e.g. to the heart and the central nervous system. Once in the muscle cell, the larvae twist into a spiral and become enclosed in a capsule. These encapsulated larvae may remain infectious for several months, even years.

There are several known *Trichinella* species, of which *T. nativa*, *T. spiralis*, *T. britovi* and *T. pseudospiralis* are also present in Europe and also in Finland. The most common species in Finland are *T. nativa* and *T. spiralis*.

7.4.1. Trichinellosis in humans

Humans can be infected with trichinellosis by eating undercooked pork, bear or other meat or meat product containing larvae of trichinella. After eating, the Trichinella larvae are released in the intestines and mature into adult worms. The larvae produced by female worms are carried to the striated muscle where they become enclosed in a capsule. The severity of symptoms depends on the number of larvae. The infection can be asymptomatic.

In Finland, the last known trichinellosis case in humans was an infection transmitted from bear meat in the 1970s.

7.4.2. Trichinella in food

The *Trichinella* parasite is prevented from entering food during the meat inspection of slaughtered animals.

Trichinellosis originating from horse and wild boar meat has caused several epidemics in humans, for example, in Central and Southern Europe. In Finland, all slaughtered animals that may be trichinella hosts are tested for trichinella infection. These animals include pigs, wild boars, horses, bears, seals, badgers and other carnivorous game. The carcass and organs of an animal carrying the trichinella parasite are destroyed.

7.4.3. Trichinellosis in animals

Trichinella species are parasites of carnivorous mammals and they have several host animal species. In animals, the infection is usually asymptomatic or has mild symptoms.

The monitoring of the occurrence of trichinella is based on meat inspection of domestic animals and game. Furthermore, the occurrence of trichinella infections is monitored in wild animals. In the 2000s, in meat inspection an average of 1,250 slaughtered horses were tested for trichinella each year. In Finland, there have never been cases of trichinellosis diagnosed in horses.

The number of infections in pigs declined rapidly in the 2000s, and only one trichinella infection, in 2010, have been found in pigs since 2004.

Still in the 1990s, trichinella infections were found every year on a few pig farms, with the highest number of findings made in 1996. The number of trichinella-positive pigs on an individual production farm varied from a few animals to even over a hundred animals. In 2000–2010, a total of 58 pigs originating from seven different farms were found to be infected with the trichinella parasite. The change in the 2000s is assumed to be due to the structural change in pig farming, as a result of which the number of pig farms most susceptible to infection has fallen.

Trichinella infections have also been found in farmed and wild boar and in bears. A few hundred wild boars are tested for trichinella parasite each year (an average of 760 per year in the 2000s), the majority of which have been farmed and only 4–21 have been wild. Of the wild boar tested each year, 0–2 have had a trichinella infection. In the 2000s, an average of 62 bears were also tested for trichinella parasite each year.

Trichinella infections in wild carnivorous mammals are fairly common in Finland. Occurrence in lynxes, wolves, raccoon dogs and foxes is high.

Animal species	number of animals tested	percentage of animals testing positive
Lynx	1147	44,5
Wolf	291	34,0
Raccoon dog	1927	29,8
Fox	2333	20,6
Weasel	299	11,7
Rat	74	8,1
Bear	709	7,5
Wild boar	74	6,8

Table: *Monitoring of Trichinella spp. in wild animals in 2000–2010 (Source: Evira)*

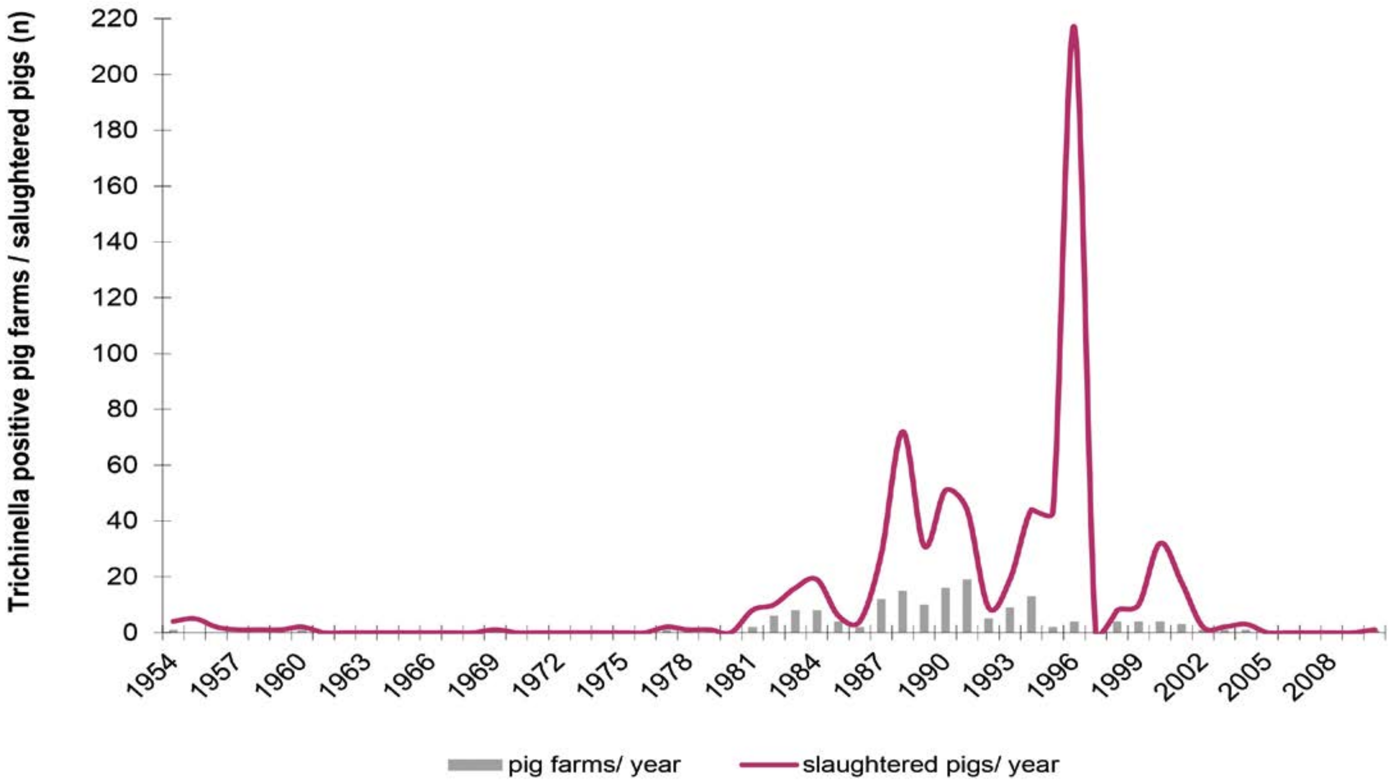
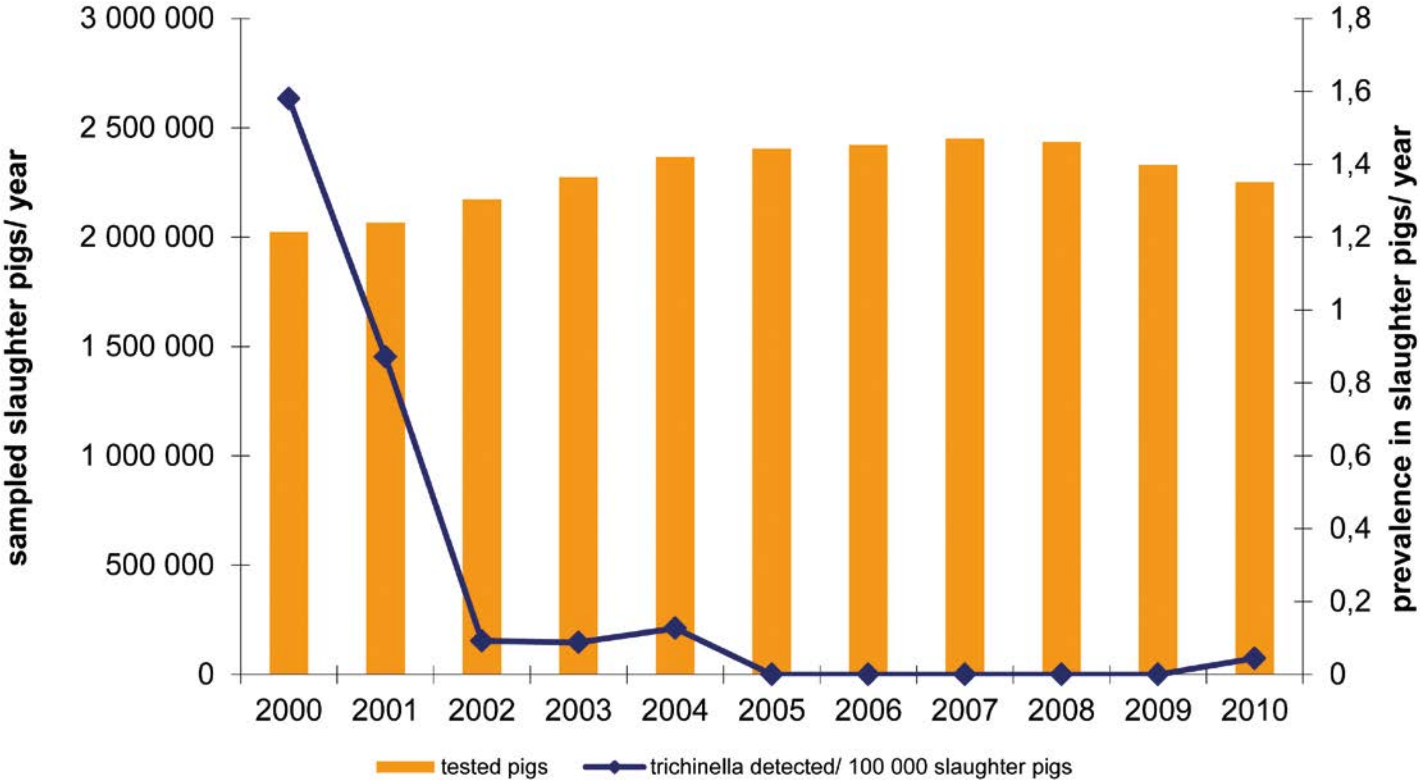


Figure: *Monitoring of trichinella in slaughter pigs and pig farms between 1954 and 2010 (Meat inspection statistics, Evira)*



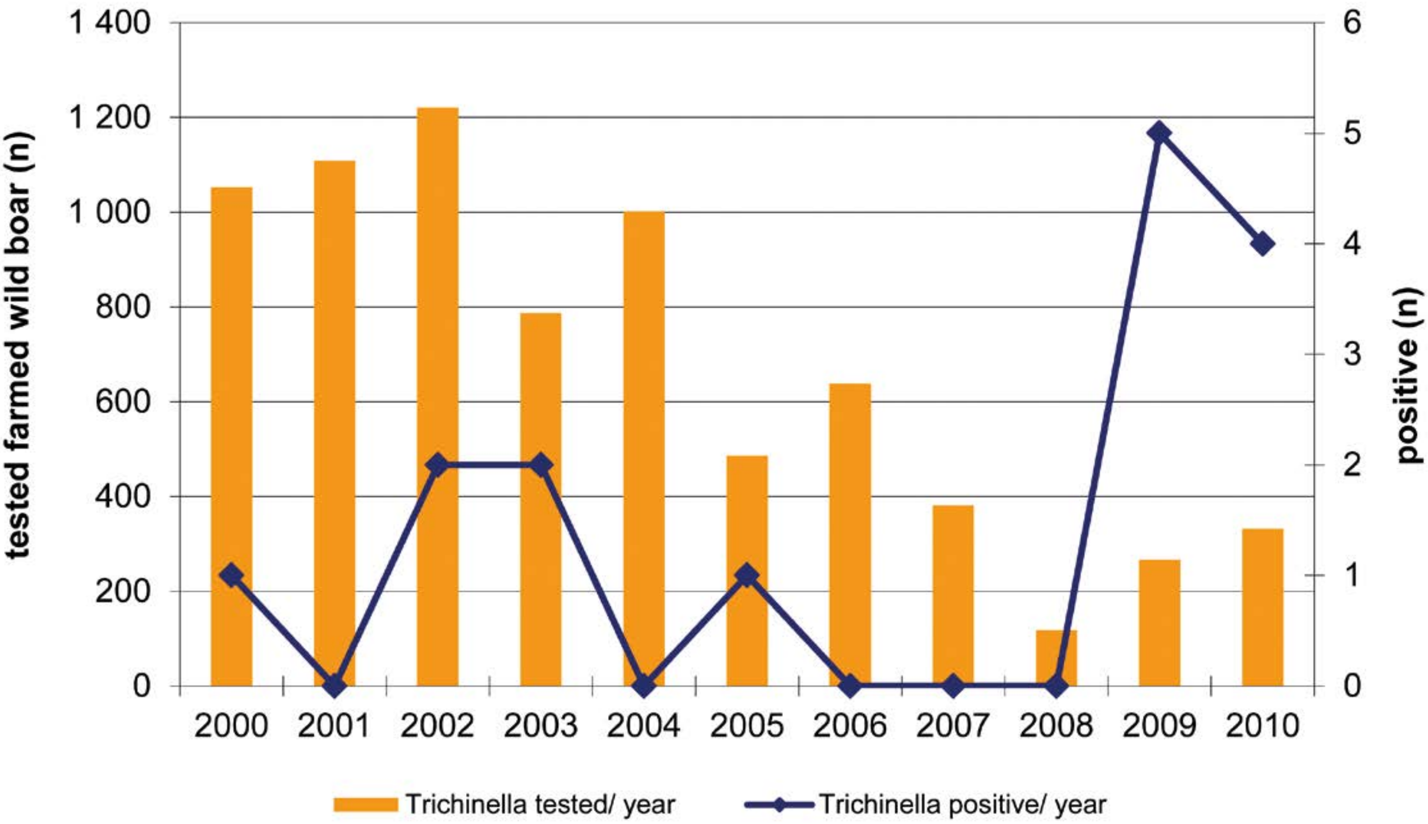


***Figure a–b:** Monitoring of the occurence of the trichinella parasite in 2000–2010 a) in slaughter pigs b) in slaughtered farmed wild boar (Source: Meat Inspection, Evira)*

8. Diseases caused by prions

8.1. New variant Creutzfeldt-Jakob disease (vCDJ) / BSE

Transmissible spongiform encephalopathies (TSE) are diseases caused by prions, resulting in a spongy degeneration of the brain tissue, and death. The most commonly known prion disease is BSE (Bovine Spongiform Encephalopathy), or mad cow disease, which was diagnosed for the first time in Great Britain in 1986. In humans, the disease is known as new variant Creutzfeldt-Jacob disease (vCJD). The probable connection between human vCJD and BSE was published in 1996.

8.1.1. vCJD in humans

The prion causing the new variant Creutzfeldt-Jacob disease (vCJD) has probably been transmitted to humans through bovine food although it has not been possible to conclusively demonstrate the infection route. The new variant Creutzfeldt-Jakob disease has been a nationally notifiable infectious disease in Finland since 1998. Surveillance is organised by neurologists and neuropathologists who investigate the CJD cases in Finland. Samples of suspected cases are sent to an international reference laboratory to confirm the diagnosis. No cases have been found in humans in Finland.

8.1.2. BSE prion in food

Beef products are regarded as the source of the prion that causes a new variant Creutzfeldt-Jakob disease (vCJD) in humans. The spread of the BSE prion through food is prevented in connection with slaughter. To protect consumers, so-called high-risk material, such as the brains and spinal cords of cows, which are regarded as the most significant tissues in terms of occurrence of the prion, are destroyed in connection with slaughter. From the beginning of 2001 some slaughter cattle, from the beginning of 2002 all slaughter cattle over 30 months old and from the beginning of 2009 all slaughter cattle over 48 months old have been tested for BSE prion before accepting them to be used as food. Furthermore, all cattle aged 24–30 months that were subject to special emergency slaughtering were also inspected until 2008. No BSE prion has been found in a single healthy slaughter cattle in Finland.

8.1.3. BSE in animals

At the present time, BSE is thought to spread mainly through feed contaminated with meat-and-bone meal derived from ruminants. The studies support the theory that meat-and-bone meal produced from the slaughterhouse waste of scrapie sheep is a source of BSE. It has also been suggested that meat-and-bone meal produced from the slaughterhouse waste of cattle suffering from spontaneous BSE is a source of BSE. For this reason, the use of meat-and-bone meal was banned first in the feed of ruminants and then in other animal feed.

The basic principle for preventing BSE in animals has been to stop the recycling of material that transmits the infection in the feed chain. The prevention measures will hopefully result in the eradication of BSE in the cattle in the EU countries within the next decade.

An EU-wide active BSE monitoring programme was launched in 2001. BSE monitoring is based on extensive testing of ruminants, consisting of tests on slaughter cattle and BSE testing of cattle which have died on farms or are presenting neurological symptoms. All cattle that die on farms or have neurological symptoms are tested because they would be most likely to manifest the disease. In early December 2001, the first and so far the only BSE case in Finland was diagnosed in a cattle. The case was discovered in the monitoring of cattle risk groups.

8.1.4. BSE prion in feedstuffs

The spread of BSE prion through feed is prevented by controlling the use of meat-and-bone and fish meal and other animal proteins in animal feed. In Finland, the use of imported meat-and-bone meal in the feeding of ruminants was banned already in 1990. The use of Finnish meat-and-bone meal for ruminants was banned in 1995. As from 2001, the ban was extended to also apply to the feed of other animals meant for food production, such as feed for pigs and poultry, in addition to cattle feed. The possibility of cross contamination of feed was removed with the ban. All measures aim to reduce human exposure to the source of BSE.

The use of animal protein is controlled in terms of its storage, transport, import, export, feed manufacture and market entry. Its use is also monitored on farms. Monitoring is carried out with inspection visits and sampling according to a plan drawn up each year.

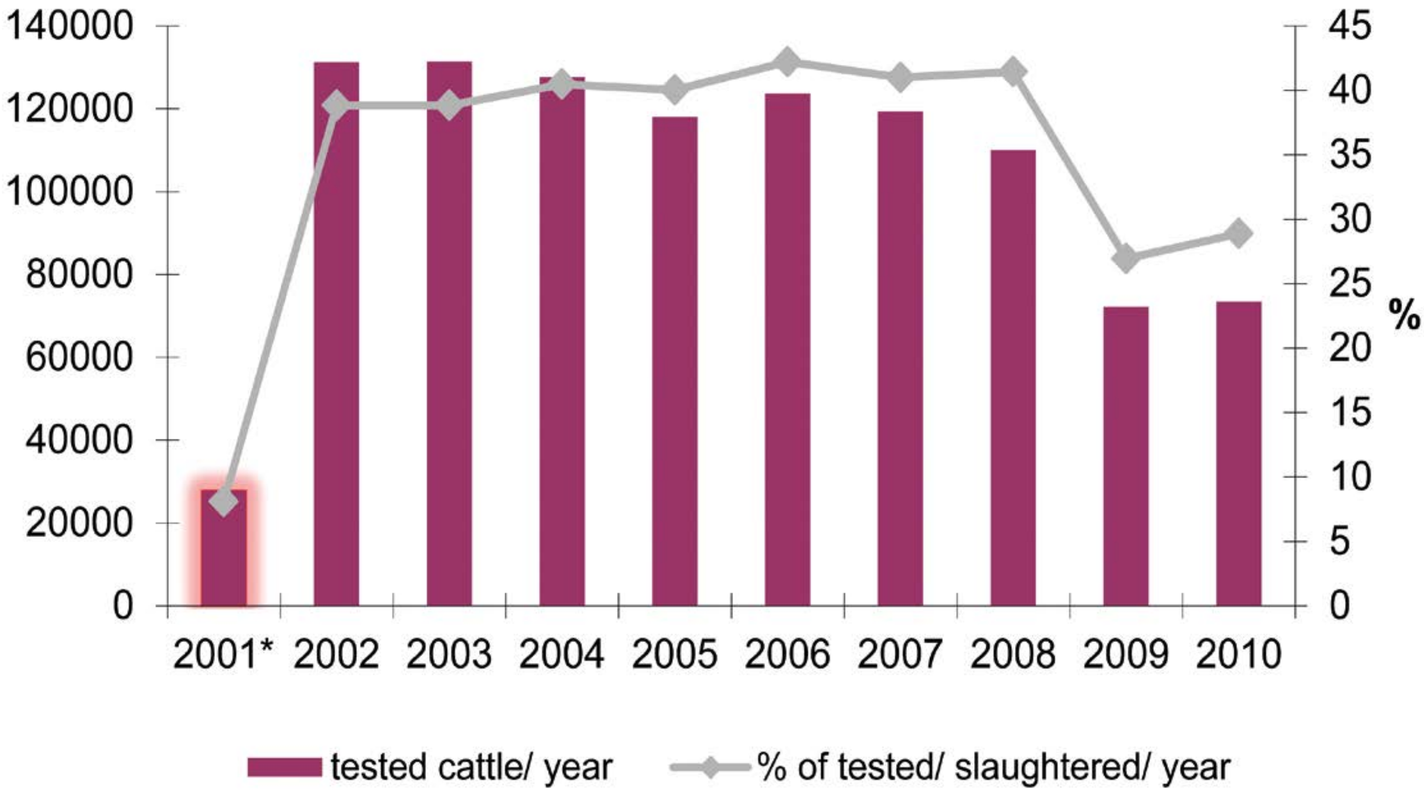


Figure: *BSE monitoring studies on cattle (Source: Evira)*

Case report – BSE in a Finnish cattle in 2001

In Finland, BSE has been diagnosed only once. In the study of risk groups, one BSE infection was discovered in early December 2001. The infected animal, showing clinical signs, was a dairy cow from Northern Finland, six years old and born in Finland. Investigations could not indicate the source of the BSE infection. The sick animal was put down and its carcass was destroyed. The other animals in the cattle and the offspring of the BSE-positive animal, which according to an epidemiological study could have been infected, were also put down and destroyed. All of the animals' secretions were destroyed and the facilities were disinfected. Due to the BSE case, testing of healthy cattle over 30 months old for BSE was started in Finland in addition to testing of so-called high-risk animals. Until December 2001, only animals classified as high risk had been tested in Finland, including cattle exceeding the set age limit and subject to special emergency slaughtering, cattle that had died on farms, and animals with symptoms of the central nervous system.

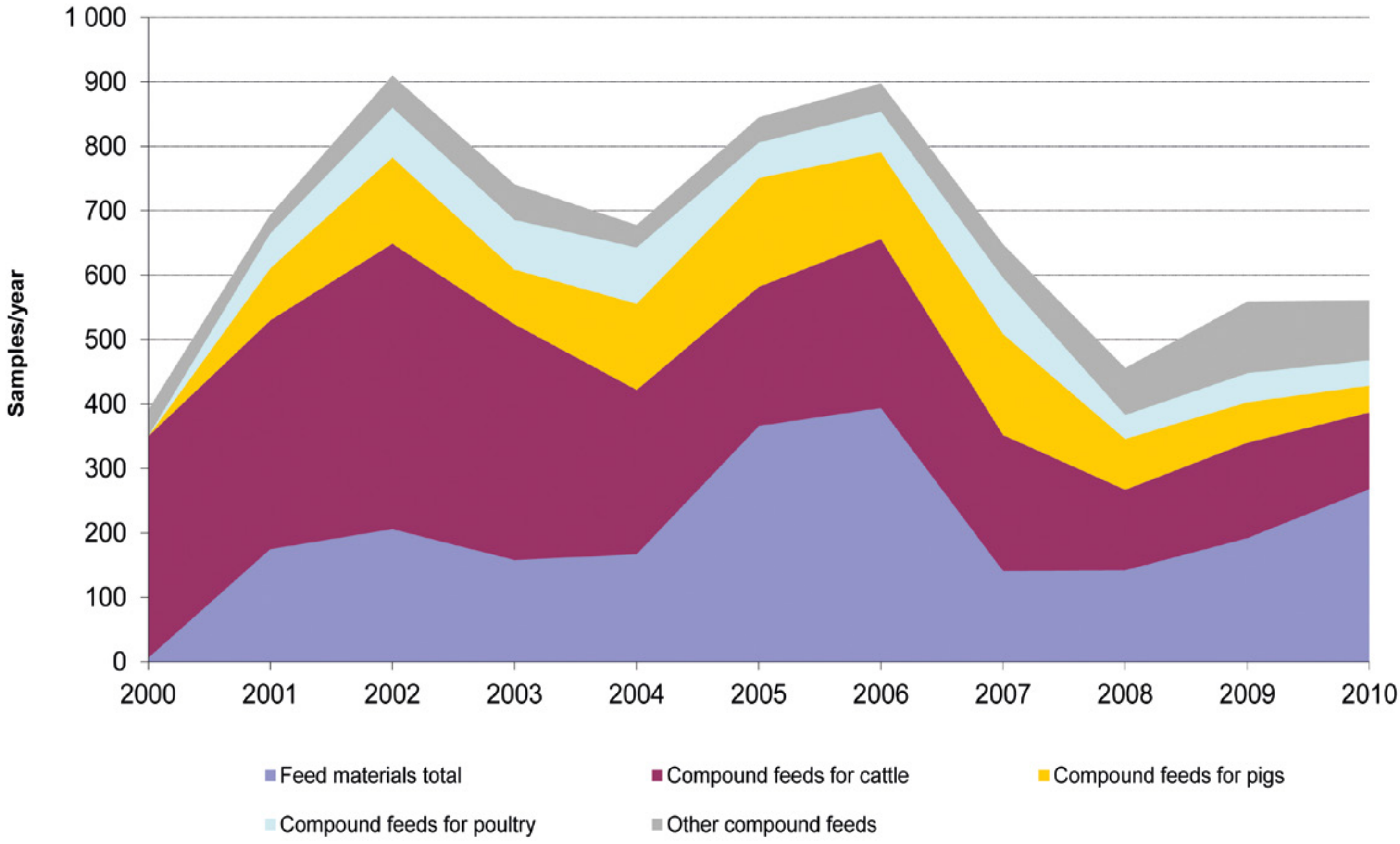


***Figure:** Feed samples tested for meat-and-bone meal in 2000–2010 (Source: Feed Control, Evira)*

Further information in Finnish and Swedish on the website

www.zoonoosikeskus.fi

Zoonoosikeskus

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