WILDLIFE DISEASE SURVEILLANCE IN SWEDEN 2023

SVA report 93:2024

SWEDISH VETERINARY AGENCY

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Photo, cover: Dead wild boar. Photo: Erik Ågren. African swine fever was found for the first time in Sweden in September 2023 when attentive hunters reported an increased number of dead wild boar in the vicinity of Fagersta.

Photo, others: SVA if no byline is written with the image.

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Introduction

2023 was an interesting and exciting year for wildlife health and diseases, where serious infectious diseases in wildlife were highlighted more than ever, with a strong focus on African swine fever. Here we summarize the activities and events in 2023 for an overview of the health and disease situation in wild animals in Sweden. Results are based on SVA's work in the general wildlife disease programme and projects focused on wildlife diseases. This annual report also serves as an account of the work carried out with funds from the Wildlife Conservation Fund (Viltvårdsfonden), which partly finances the wildlife work at SVA.

Uppsala, 27 March 2024
Erik Ågren, Head of the Wildlife section
Aleksija Neimanis, Head of section for Research and Development

Summary

The health status of Swedish wildlife

References: SVA Annual report 2022, SVA Wildlife section and SVALA database 2023.

The year when African swine fever came to Sweden, 2023! This was the biggest event of the past year for those of us who work with wildlife diseases. The outbreak in wild boar in Fagerta had a serious impact on the local community. However, from a disease control perspective, the infection itself seems to have been successfully managed. The health situation of Swedish wildlife is in general good.

Surveillance of wildlife diseases is mainly done through necropsies and ancillary tests of found dead wildlife, and some targeted surveillance with active sampling. Reporting from the public and other authorities contributes up-to-date knowledge to SVA's monitoring. The focus is on the diseases of wild animals that can be transmitted to or from domestic animals or humans, and those that are likely to affect wild populations, especially in the case of endangered species.

African swine fever was detected in September 2023, for the first time in the country, as a point introduction in Fagersta municipality. The monitoring of sick and dead wild animals by reporting from the public worked well and led to rapid action by the responsible authorities. SVA played a prominent role in the work showing that the infection was limited to a small area and already seemed to be under control by the end of the year. However, much work remains to be done to ensure that the disease has been eradicated and for the country to be declared free of this virus again.

Avian influenza infections continued in 2023 with, among other things, major outbreaks in black-headed gull colonies. Notably, and new for the year, the circulating variant of influenza virus also affected red foxes and other mammals that likely ate sick and dead birds, a finding described from many other countries this year.

In 2023, 1,938 fallen wildlife were registered at SVA; 980 mammals, of which 283 were wild boar, 944 birds and 13 amphibians. The number of cases of infectious diseases requiring mandatory reporting to the Swedish Board of Agriculture was 234. An additional 148 cases of infections were reported voluntarily, giving a total of 382 reported cases among 28 wildlife species.

The national monitoring for the fox tapeworm parasite began in 2021. Two isolated findings of the infection were found in samples analysed in 2023, but collected in 2022 from Borlänge and Avesta municipalities, respectively. In 2023, detection of the parasite also continued in Gnesta municipality.

As part of the programme for health and disease surveillance of marine mammals, SVA, in collaboration with the Swedish Museum of Natural History, performed necropsies on 43 porpoises and 22 seals during the year to increase knowledge about these species.

A total of 1,165 large carnivores were registered at SVA in 2023 (compared to 987 in 2022). SVA's mission is that all bears, lynxes, wolves, and wolverines that are found dead or killed during hunting or other circumstances, should be examined as whole carcasses or through standardized sample collection. The results show that large carnivores generally have good health status.

Wildlife disease focus

ASF 2023

AFRICAN SWINE FEVER – THE FIRST OUTBREAK IN SWEDEN

September 6, 2023, became a historic day in Swedish wildlife disease surveillance, when African swine fever was detected in a sample from a dead wild boar from Fagersta municipality. Thanks to good surveillance, the outbreak was detected early and the infection was limited to a smaller area. Great efforts from authorities, the local community and volunteers were made and there is a good chance to eradicate the disease. Eradication efforts continue in 2024.

The ongoing African swine fever (ASF) epidemic in Europe started in 2007 in Georgia and spread to the EU in 2014 when Lithuania was affected. Since then, the Swedish Board of Agriculture (SBA) has coordinated preparedness plans to prevent introduction, and together with SVA, to detect and combat an outbreak if ASF is found in the country.

Coordination meetings and exercises have been held on an ongoing basis to involve all authorities, industries and interest groups that could be affected by an outbreak. On September 6, 2023, SVA was unfortunately able to announce that the first case of ASF had been detected in a wild boar in Sweden.

Part of a wild boar forelimb in SVA's necropsy room. The sample in the image became the first case of African swine fever in Sweden on September 6, 2023. Photo: Erik Ågren, SVA.

Low risk for introduction

SVA monitors the ASF situation in Europe and conducts risk assessments that are updated as necessary. During the ongoing epizootic in Europe, Sweden has been assessed as being at increased risk for ASF introduction, albeit at a low level.

ASF introduction into Sweden was seen as a rare event. It was the result of a chain of low probability events that, in sequence, allowed for the virus to be imported from an infected area and infect wild boar within Fagersta municipality.

What happened in Fagersta

Fagersta is surrounded by forests and lakes. In the forest east of Fagersta, hunting is conducted by different hunting teams. At the end of August 2023, hunters were out in the woods preparing for the autumn hunt. Several dead wild boars were noted by different people in the last week of August. This led to the reporting of these findings to SVA through the web-based reporting system rapportervilt.sva.se.

The weather was warm and the foul-smelling boar carcasses were easily noticed when one got close. An obviously sick wild boar lying in a puddle in a ditch was also found, euthanised and reported. SVA contacted the reporter on the same day as the first reports came in, but it became apparent that the bodies were no longer available for sampling.

The following week, another rotten wild boar carcass was reported and this time a sample was taken and sent to SVA. To avoid duplicate reporting of the same carcass, SVA asked the reporter for a map of where all wild

This wild boar found dead in Fagersta municipality became the first case of African swine fever in Sweden. Photo: Private.

boar had been found dead. SVA received the sample and a map on September 5. The following day ASF was verified. The map showed six dead wild boar within a 3 km zone. SVA reported the positive case to the SBA, relevant ministries and the EU. Sweden was now the 24th country in Europe to be affected by ASF.

Outbreak eradication

A flurry of activities was initiated to investigate and eradicate the outbreak. The SBA is responsible for the management of these outbreaks, and a pre-existing action plan was activated. The location of the outbreak was unexpected, in the far north of the range of wild boar. SVA's expert group on ASF convened on 6 September. On 8 September, SVA and the SBA were on site in Fagersta. A first task was to determine how widespread the outbreak was.

Road sign warning of entry into the ASF infected zone on a road that goes through Fagersta. Photo: Erik Ågren, SVA.

Based on a proposal from the expert group, the SBA defined an infected zone of about 1 000 km^2 in accordance with regulations of the European Commission. This area was subject to severe restrictions under the Epizootics Act. The right of public access was limited and access to forest and nature beyond vehicle roads was only allowed with a permit and biosecurity training. The restrictions were aimed at preventing disturbance of wild boar and contamination of shoes or other items so that neither wild boar nor ASF virus would leave the area. All domestic pigs in the area were culled.

The Swedish Association for Hunting and Wildlife Management (SAHWM) very quickly coordinated the local hunters who had volunteered to perform a systematic search of the forest where the carcasses were found. Participation in the search required biosecurity training by SVA or SBA staff. The search was carried out by teams of two people, each searching their assigned areas. The search started where the first carcasses were found and moved outwards. Within each search area, the hunters focused on terrain where wild boar typically were found, i.e. the wettest and most inaccessible parts of the forest. Search areas and carcass locations were mapped, largely with the help of the WeHunt® app used by many hunters, and with map processing by SVA's data analysts and epidemiologists. Wild boar carcasses were labelled when found, then collected by teams staffed by voluntary organizations (Blå Stjärnan (Blue Star) and the Volunteer Automobile Corps) and taken to a local sampling centre where tissue samples were taken and sent to SVA for analysis. The carcasses were then burned in a mobile incinerator.

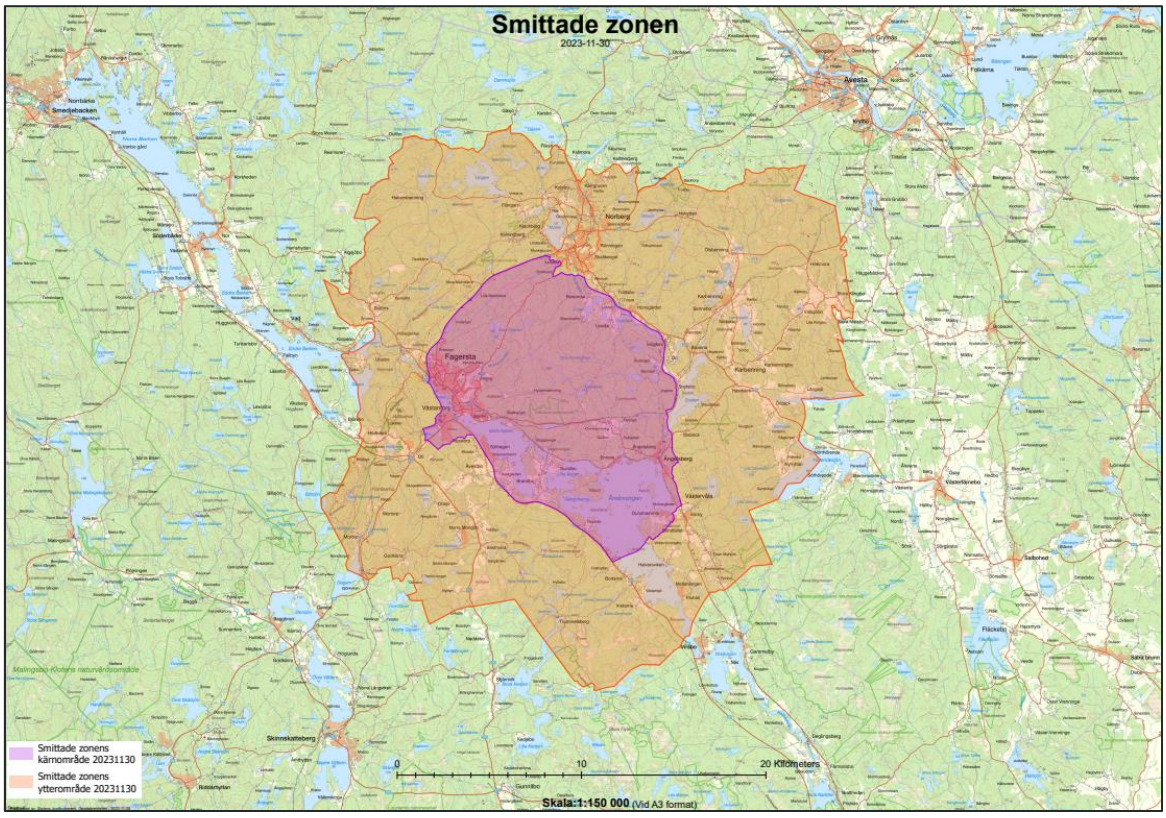
Three ASF experts from the EU visited SVA and Fagersta for discussions and support and to provide recommendations for the outbreak management and planned measures. Sweden's management and plans were highly praised.

Within the first three weeks, 45 carcasses or remains of wild boar were found positive for ASF, as well as a few old skeletal remains that were negative. All positive cases were within a maximum distance of just over 5 kilometres from each other. After three months, it was established that the infection was limited to this core area, EU regulated zones could be applied and the restricted area was reduced to just over 600 km^2. A core area of just over 100 km^2 was fenced off to prevent the last living wild boar from leaving the area.

Existing game fences along major roads were reinforced with a ground covering net along the lower fence edge. Stretches of road along the core area periphery that lacked wildlife fences were supplemented with a new fence. From November, the remaining wild boar were culled at bait stations or after trapping in live-capture traps. By tracking in snow covered ground, the last few wild boar could be found and culled.

An analysis of how old the infected wild boar carcasses were was done to estimate date of death. Results showed that the outbreak may have started in May-June 2023. Given that Fagersta is so far removed from any other ASF-infected area, it is believed that the virus was brought to Sweden by humans and then made its way into the environment where wild boar could ingest it to become infected. This outbreak is considered a rare event in Sweden. Just like before the outbreak, the risk of a new ASF outbreak in Sweden is assessed as elevated, but at a low level. The spread of ASF between wild boar is faster in denser populations. The greatest density of wild boar in the Fagersta area was around the waste disposal facility in the central part of the core area. The outbreak has had a major impact on the local community, but fortunately, the infection was found before it had spread too far. The control measures appear to have been successful, largely due to the fantastic efforts of local and volunteer forces.

If no more positive cases are found, Sweden could be declared free of ASF as early as the autumn of 2024. The responsible authorities have gained a lot of experience in managing this outbreak and fine-tuning details. They have also been able to identify risks that have not been highlighted much before, such as biosecurity at waste and recycling facilities where wild boar are present. Further information on the outbreak can be found on the websites of SVA and SBA.



Map of the ASF zones in Fagersta and Norbergs municipalities. Pink: Core area, RZ II. Yellow: Surveillance zone, RZ I. Source: SVA and SBA.

PHD PROJECT ABOUT ASF AT SVA

Pathological lesions

A PhD project on ASF pathology has been ongoing for a few years. Veterinarian Emil Wikström Lassa at SVA is studying the pathology of ASF in collaboration with Swedish and international researchers. They are investigating organ lesions throughout the course of the disease in both wild boar and domestic pigs. During the Fagersta outbreak, tissue samples from freshly dead wild boar were collected to compare the natural disease with experimental studies, and wild boar with ASF in other countries. Recognition of pathological lesions of ASF infection is vital for early detection of disease incursion.

Wild boar - domestic pig interface

The PhD project *Wild boar near the farm* focuses on how infections such as ASF and salmonella can be transmitted between wild boar and domestic pigs in Sweden. Veterinary epidemiologist Linda Ernholm at SVA is studying how contacts between wild boar and pigs occur and how common they are, to acquire knowledge for strategies to avoid transmission of infections between populations. Data from the wildlife disease surveillance is also used in this project.

Veterinarian Emil Wikström at SVA is a PhD student investigating pathology of African swine fever. When the outbreak in Fagersta was detected, he was in the field in early September 2023 and was able to take samples both for swine fever virus analysis but also for his research. Here he is sampling a dead wild boar sow is that was found lying dead on its nest in the forest. In the summer heat, dead wild boars could easily be found by smell alone, even in dense thickets. Photo: Estelle Ågren.

AVIAN INFLUENZA – IN BOTH BIRDS AND MAMMALS

Highly pathogenic avian influenza (HPAI) type H5N1 continued to circulate among wild birds in Europe, North America, and South America in 2023. In October, the virus was detected for the first time in Antarctica. This year, mammals were also affected.

Photo: Sick black-headed gull affected by avian influenza during the outbreak at the lake Råstasjön in Stockholm in April 2023. Photo: Leif Arnerdal

In Sweden, highly pathogenic avian influenza type HPAI-H5N1 was detected in 152 birds of 27 species in 2023 (see table below). Between January and March, the infection was mainly detected in geese and birds of prey. At the end of April, widespread mortality started in black-headed gulls in Lake Råstasjön in Stockholm, where more than 800 black-headed gulls were found dead.

For the rest of the spring and summer, the infection in black-headed gulls dominated the country. Large outbreaks in black-headed gulls were noted in the counties of Kalmar, Uppsala, Gotland and Blekinge. On Gotland, many guillemots and razorbills also died from avian influenza during the summer.

However, the number of cases investigated does not reflect the number of dead or positive birds at a site as only a small number of birds are selected and sent to SVA for analysis. Thus, the total number of birds that have died from avian influenza is much higher than what is reported by SVA.

The high mortality rate in wild birds resulted in many reports from the public in the online form **rapporteravilt.sva.se**, by email and through phone calls. In total, SVA received 2928 reports of sick or dead birds to rapporteravilt.sva.se between 1 January and 31 August. There were 582 reports about gulls (mainly black-headed gulls) and 310 regarding guillemots and razorbills. Most reports came from counties with large outbreaks: 705 came from Gotland, 562 from Stockholm, 313 from Kalmar, 259 from Västra Götaland, 228 from Skåne and 142 from Uppsala. Each report could include one or more dead birds. It is possible that some reported birds died from other causes, but the large number of reports of the same species in a limited geographical area strongly suggests influenza and gives an indication of the extent of mortality.

During the autumn (Sep-Nov) only five cases of avian influenza were detected, two of which were birds that had been found dead in July but arrived later to SVA. In December, the virus was detected in 11 birds, including nine barnacle geese from Blekinge, Skåne and Kalmar.

Mammals affected

In 2023, avian influenza was also detected in several species of mammals around the world including badgers, ferrets, mink, otters, skunks, raccoons, opossums, lynxes, red foxes, coyotes, bears, bobcats, dolphins, seals and domestic cats.

In Sweden, 14 out of 46 red foxes tested were positive for avian influenza in 2023. Most were dead pups, but one live fox had neurological symptoms and one fox was shot during regular hunting. The foxes are likely to have been infected by eating infected birds. Post-mortem examination revealed feathers in the stomach and intestines of some of the fox pups and the mortality coincides with the mortality of black-headed gulls.

Studies of positive animals show that the virus is almost always present in large quantities in the brains of both birds and foxes. This gives rise to the abnormal behaviour (neurological symptoms) often observed in infected animals found alive. There is no evidence yet that the virus has spread directly between wild mammals, but it is important to continue to identify which species are infected by avian influenza, how it spreads and whether the virus is changing to become more adapted to mammals.

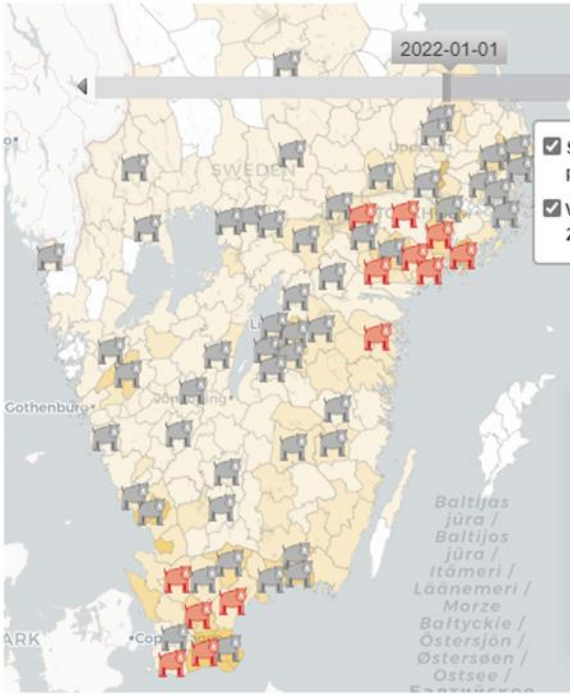
Fox pup found dead in Stockholm, May 2023. The cause of death was infection with avian flu virus. Photo: Joao Yazlle

Table of the number of dead wild birds sampled for avian influenza and the number of positive cases in 2023. Some cases could not be fully typed. In addition, the number does not reflect the total mortality of avian influenza per species as only a small number of dead birds per site are sent to SVA for analysis. This is especially true in cases of more extensive mortality with many dead birds of the same species at the same site.

Bird species	AIV-positive	AIV-negative
Eurasian Eagle owl	4	11
Northern Goshawk	4	18
Common Eider	1	3
Common gull	4	6
Common tern	1	3
Rough-legged Buzzard	1	2
Greylag Goose	5	6
European Herring gull	7	15
Mallard	1	10
Great Black-backed Gull	3	4
White-tailed Eagle	2	58
Heron	1	1
Sandwich tern	2	6
Mute swan	2	19
Common Buzzard	4	12
Peregrine Falcon	10	8
Common Guillemot	5	11
Lesser Black-backed Gull	3	3
Eurasian Magpie	2	24
Black-headed Gull	56	11
Purple Sandpiper	1	0
Great Cormorant	1	16
Eurasian Oystercatcher	2	1
Whooper swan	3	6
Razorbill	2	2
White stork	2	3
Barnacle Goose	23	5
Total	**152**	

SALMONELLA CHOLERAESUIS IN WILD BOAR

Mapping of Salmonella in wild boar has continued in 2023, and 13% of surveyed animals had the bacteria. The infection is more widespread in certain areas. The map shows that surveillance is not yet comprehensive, so further sampling is needed.



Follow the monitoring of Salmonella bacteria in wild boar on sva.se

In 2020, the bacterium *Salmonella* Choleraesuis was found in domestic pigs in Skåne. It can cause blood poisoning and sudden death in domestic pigs and wild boars. This salmonella has not been detected in Sweden for about 40 years, so it was a surprising and undesirable finding as Sweden has a low incidence of salmonella in production animals in the country.

In 2023, continued monitoring was carried out both on found dead wild boar and on samples submitted from wild boar killed during hunting from hunters around the country.

In total, 38 of 301 wild boars sampled in 2023 were positive for salmonella bacteria, of which 29 were *S.* Choleraesuis. Of the 153 fallen wild boar cases submitted during the year, *S.* Choleraesuis was detected in 22 cases, and other salmonella variants in two cases. Out of 148 samples from wild boar killed during hunting, seven were positive for *S.* Choleraesuis and seven cases were other salmonella types.

The bacterium *Salmonella* Choleraesuis is thus more frequently detected in wild boar found dead or euthanised due to disease. Positive cases have been found in 2023 in the counties of Skåne, Södermanland and Östergötland. Individual positive cases have also been found in other counties. It is likely that more counties will find cases over time as surveillance continues. See www.sva.se for a map of the infection situation.

All types of salmonella can cause disease in humans. The Swedish Food Agency advises that careful hygiene during evisceration and slaughter is important and that it is possible to eat apparently healthy wild boar even if they carry the infection in their intestines. However, sick animals should not be eaten!

CIRCOVIRUS IN WILD BOAR

Circovirus attacks the immune system and may explain increased mortality in wild boar piglets. This virus may contribute to the decline of the wild boar population.

Porcine circovirus type 2 (PCV-2) is an important infection in domestic pigs because it is immunosuppressive and can lead to the piglet disease PMWS (post-weaning multisystemic wasting syndrome) characterised by rapid wasting, diarrhoea, pneumonia or acute death. The virus can also cause reproductive disorders if sows are infected during pregnancy.

Research in domestic pigs shows that co-infection with PCV-2 and *Salmonella* Choleraesuis causes more severe disease symptoms and that animals excrete the bacterium for a longer period than those infected with salmonella alone. Wild boar that are necropsied are therefore also tested for PCV2 to map the virus in the wild boar population. Received lymph nodes for salmonella screening are also analysed for PCV-2.

In 2023, lymph nodes from 103 wild boar were analysed for PCV-2. Of these, 58 were collected from healthy wild boar during hunting and 45 from fallen wildlife. In total, virus was found in 52 (50%) of all tested wild boar. Virus was detected at a higher rate in fallen wildlife (64%) compared to wild boar killed during hunting (40%). Out of 100 wild boar tested for salmonella, this bacterium was found in 13 cases, and of these 10 were positive for both salmonella and circovirus.

The results show that the prevalence of PCV-2 is high in the Swedish wild boar population and warrants further investigation. Many wild boar carry circovirus, and the next step is to look for pathological changes linked to the presence of the virus, and the importance of co-infection with other infections, such as salmonella bacteria. The study is continuing in 2024.

Left: Markedly enlarged and blood-filled lymph nodes of a wild boar infected with both PCV2 and salmonella. On the right: Pneumonia in a boar infected with PCV2 and lungworms.

SUCCESSFUL TREATMENT OF SARCOPTIC MANGE IN ARCTIC FOXES

Several outbreaks of Sarcoptic mange have affected Swedish Arctic foxes. Treatment of wild animals is rarely done but has been carried out to save the endangered Arctic fox.

In Sweden, arctic foxes in the mountains of Stekenjokk have been affected by Sarcoptic mange, both in Jämtland and Västerbotten counties, in 1986-87, 2013-14, 2017, 2019, 2020, and 2021. In December 2021, the Västerbotten County Administrative Board invited SVA and other stakeholders to a first meeting arising from concern over the outbreaks that are also seen in Norway.

Historically, the 1986-87 outbreak was diagnosed by SVA and treatment was done by trapping foxes and injecting ivermectin. Recaptures in 1988 showed a good effect of the treatment.

In the 2013-14 outbreaks, SVA was also involved and confirmed infection. At that time, treatment was available as pills, so medication was administered in sausages placed around the dens. Nine infected dens in 2013 increased to 19 in 2014. It took two years for the outbreak to subside, after repeated treatments. It is estimated that every third Arctic fox in the area was infected in 2014. All subsequent outbreaks have been contained within a year, as only a few isolated dens have been affected. Camera trap images show that affected individuals have recovered, with normal fur cover some time after treatment.

The present status of the Arctic fox is excellent. In early 2000s, the population was only around 40-60 adults, but in 2023 it is estimated that there will be about 560! However, the larger the population, the greater the risk that they will encounter mange or other infections, mainly from red fox that are spreading higher up into the mountain area.

Text: Malin König, National Coordinator for the Arctic fox programme, Västerbotten County Administrative Board, and Erik Ågren, SVA.

Mangy Arctic fox with loss of fur on the tail and ventral parts of the body. Since the 2000s it has been possible to treat Sarcoptic mange with oral medication added to food items. The treatments have been successful, and outbreaks have been managed without having to physically capture the animals. Photo: Västerbotten County Administrative Board.

You are our eyes and ears

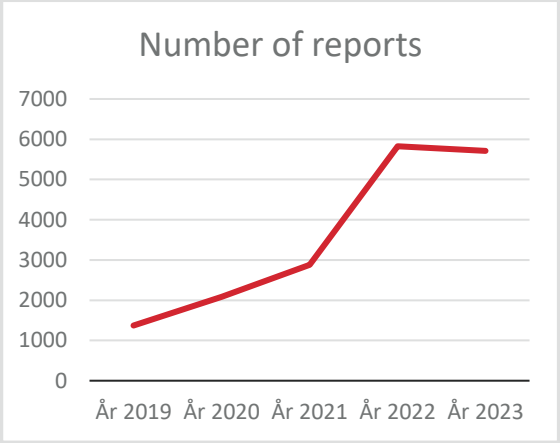
SVA is dependent on reports from the interested public around the country to acquire information on where and when wildlife disease or mortality events occur.

We at SVA are very grateful that so many people are involved and submit reports to the wildlife section - online at rapporteravilt.sva.se or by email or telephone. This citizen science effort is the basis for general wildlife disease surveillance! Dealing with all the reports and communications concerning wildlife on a daily basis is usually more than one person working full-time can manage. The statistics below for 2023 show that many people contribute to our wildlife disease surveillance. The advantage of receiving reports online through **rapporteravilt.sva.se** is that data are automatically entered into our maps and tables, making it easier to detect signs of increased disease or mortality events.

rapporteravilt.sva.se

SVA's online reporting form to report dead or diseased wildlife.

Graph of number of reports in the online form rapporteravilt.sva.se the last five years. Each report may represent one or several affected wild animals.



Number of reports for 2023 in rapporteravilt.sva.se, for different classes of wildlife. One report may represent one or multiple animals.

Class	Reports 2023
Avian	3 403
Mammal	2 250
Amphibians	9
Reptiles	7
Unknown species	39
Total	**5 713**

TELEPHONE

1 305

Number of telephone calls to the wildlife section in 2023 through the SVA switchboard.

EMAIL WILD BOAR

1 283

Number of emails involving wild boar in 2023, sent to the wildlife email address vilt@sva.se

VILT@SVA.SE

Table of number of received emails and replies concerning wildlife for 2023.

Class	Number email
Avian	4 418
Deer and wild boar	2 582
Carnivores	1 355
Marine mammals	1 285
Rodents	716
Insectivores	175
Total	**10 531**

Wildlife cases 2023

In 2023, the Wildlife Section handled a total of 1,938 cases of fallen wildlife, (*i.e.* found dead or sick animals that were euthanized), through general disease surveillance. The highest number of cases per species was wild boar.

The wildlife cases are listed below in descending order of number of cases per wild species received. There was a total of 944 birds, 980 mammals and 14 amphibians. Other cases handled by the Wildlife Section but not included here are large carnivores culled during hunting, samples from healthy wildlife for targeted surveillance, and private farmed game or wildlife. Samples from wildlife are also sent to and analysed by other laboratories within or outside SVA, especially *Trichinella* analyses for wild boar and bear.

Birds	Number
Black-headed Gull	89
White-tailed Eagle	88
Rock Dove, Barnacle Goose	33
Eurasian Sparrowhawk	30
Eurasian Magpie	28
Golden Eagle	26
Common Guillemot	25
Northern Goshawk	24
European Greenfinch	23
European Herring Gull	22
Mute swan	21
Great Grey Owl, Common Kestrel	20
Tawny Owl, Ural Owl	19
Eurasian Eagle Owl, Common Buzzard, Peregrine Falcon, Great Spotted Woodpecker	18
Great Cormorant	17
Western Jackdaw	16
Common Gull	13
Common Woodpigeon	13
Greylag Goose, Caspian Tern	11
Eurasian Bullfinch	10
Long-eared Owl, Common Blackbird, Whooper Swan, Great Tit	9
Bird unknown, Mallard, Sandwich Tern, Red Kite	8
Blue Tit, Hooded crow, Gull, Hawfinch, Song Thrush	7
Northern Gannet, Lesser Black-backed Gull	6
Dove, Great Black-backed Gull, Canada Goose, Eurasian Tree Sparrow, Eurasian Sparrowhawk, Common Starling, Merlin, Black-throated Diver, Razorbill, White stork	5
Fieldfare, Chaffinch, Common Tern, Rough-legged Buzzard, Tengmalm's Owl	4
Common Eider, Common Pheasant, European Green Woodpecker, Barn Swallow, Eurasian Woodcock, Rook, Bohemian Waxwing, Eurasian Oystercatcher	3
Brambling, Eurasian Siskin, Grey Heron, Short-eared Owl, Common Goldeneye, Northern Raven, Goldcrest, Black Grouse, Common Black Woodpecker, Long-tailed Bushtit, Northern Fulmar, Western Capercaillie	2
Little Auk, European Honey Buzzard, Bluethroat, Black Kite, Western Marsh Harrier, Osprey, Common Chiffchaff, House sparrow, Grey-headed Woodpecker, Yellowhammer, Common Cuckoo, Eurasian Wryneck, Common House Martin, Northern Hawk-Owl, Common kingfisher, Common Redshank, Arctic Tern, Purple Sandpiper, Red-throated Diver, Eurasian Coot, European Goldfinch, Eurasian Curlew, Parrot Crossbill, Coal Tit, Eurasian Skylar, Eurasian Collared Dove, Great White Egret, Eagle	1
Total	**944**

Mammals	Number
Wild boar	283
Otter	137
Moose	94
Lynx	63
Red fox	59
Roe deer	47
Harbour porpoise	45
Mountain hare	44
Bat (Family)	37
Hedgehog	32
Brown bear	25
Harbour seal	15
Squirrel	14
Mountain hare	12
Fallow deer	11
Wild rabbit	10
Grey seal, Mink, Wolf	8
Badger, Hare, Wolverine	3
Dolphin, Marten, Killer whale, Ringed seal	2
Beaver, Arctic fox, Common vole, Deer, Dog, Humpback whale, Red deer, Muskox, Raccoon dog, Least weasel, Stone marten	1
Total	**980**

Amphibians	Number
Great Crested Newt	5
Pool frog	3
Common toad	3
Frog	2
Field frog	1
Total	**14**

Reportable diseases

SVA reports diagnosed cases of notifiable animal diseases to the Swedish Board of Agriculture for further reporting to international organisations.

In 2023, avian influenza and African swine fever dominated the notifiable cases.

The number of cases of reported wildlife diseases only reflects the number of diagnoses among the cases sent to SVA or other laboratories. The total number of wild animals affected by a disease is not available, but we can get an indication of whether diseases are increasing or decreasing, and we can detect introductions of new infections or diseases.

The definition of a positive case can also vary as not all cases received are verified by laboratory analysis when there are large-scale mortalities and multiple carcasses from one incident are submitted. Some carcasses are also rotten and final typing of, for example, avian influenza virus is not always possible. However, the diagnosis is avian influenza (unspecified subtype). Other cases are considered as positive even though further testing is not carried out after post-mortem examination of animals if they display changes typical of the disease. Further research and new analyses of archived materials may lead to more positive cases of a disease being found after the official statistics have been published.

A total of 234 wildlife cases of the World Organisation for Animal Health's (WOAH) listed diseases were diagnosed. An additional 148 cases were reported within the voluntary reporting of the WOAH non-listed diseases.

WOAH Listed disease	Species	Cases
African swine fever ASF	Wild boar	62
Avian influenza	Birds	138
Avian influenza	Red fox	14
Myxomatosis	Wild rabbit	4
Echinococcus multilocularis	Red fox	11
Trichinellosis	Red fox	1
Trichinellosis	Wild boar	4

WOAH Non-listed disease, and species	Cases
Lead poisoning	**18**
White-tailed eagle	15
Common goldeneye	1
Golden eagle	2
Circovirus	**16**
Wild boar	16
Pigeon paramyxovirus	**27**
Pigeon	1
Common wood pigeon	6
Rock pigeon	20
Malignant catarrhal fever	**1**
Moose	1
Avian pox	**3**
Tree sparrow	1
Great tit	2
Listeriosis	**3**
Roe deer	1
Wild boar	2
Pasteurellosis	**3**
Fallow deer	1
Red deer	1
Wild boar	1
Pseudotuberculosis	**2**
European brown hare	2
Salmonellosis	**30**
Bull finch	3
Grey seal	1
Tree sparrow	1
Black-headed gull	1
Great spotted woodpecker	1
Wild boar	23
Sarcoptic mange	**16**
Lynx	4
Red fox	9
Wolf	1
Wild boar	2
Toxoplasmosis	**1**
Mountain hare	1
Trichomoniasis	**28**
Chaffinch	2
Bull finch	1
Pigeon	1
Greenfinch	11
Eurasian siskin	1
Magpie	1
Rock pigeon	6
Hawfinch	4
Eurasian collared dove	1

Targeted wildlife disease surveillance

The Swedish Board of Agriculture finances projects to monitor certain serious animal diseases in the country. Early detection of disease introduction into Sweden and demonstration of disease absence from Sweden are important. The Swedish Environmental Protection Agency has acute action funds that SVA can apply for in the event of increased morbidity or mortality in wild animals. Various projects from 2023 are reported here.

ECHINOCOCCUS MULTILOCULARIS SURVEILLANCE

***Echinococcus multilocularis* is present very sporadically in the country and occurrence is therefore difficult to map. A hunted red fox shot in Borlänge municipality in 2022 and a red fox found dead in Avesta municipality in 2022 represented two new positive cases after analyses were performed in 2023.**

Collection of additional fox scats in 2023 in the vicinity of these two findings did not result in the detection of any more cases. Continued collection of fox scats in Gnesta municipality in 2023 showed that the infection persists in the same area where *Echinococcus multilocularis* has been present since 2011.

SVA made the first discovery of *Echinococcus multilocularis* in 2011 after ten years of monitoring hunted foxes. A first national surveillance of the parasite in red foxes was carried out during 2011 - 2014. Five local sites were found during this period by SVA and researchers at SLU, in the municipalities of Uddevalla, Katrineholm, Gnesta, Borlänge and Växjö. Follow-up sampling since 2011 shows that the infection is locally established in at least Uddevalla and Gnesta.

A second national surveillance of Echinococcus multilocularis started in 2021 and will end in 2024. The target is to collect up to 3,000 samples from foxes to monitor the infection situation in the country. The study is financed by the Swedish Board of Agriculture. A few cases of alveolar echinococcosis, the disease that the parasite causes in humans, have been found in Sweden in recent years. The Public Health Agency of Sweden therefore also has an interest in monitoring the parasite.

Samples for this second ongoing national surveillance include faeces from dead foxes and fox droppings collected from the environment. There is co-operation with the Swedish Hunters' Association to cover areas where samples from the public are missing. Samples are collected and analysed at SVA. The results are available online at SVA Echinococcus surveillance map

TRICHINELLA

In 2023, four cases of *Trichinella* were detected in wildlife – in three wild boar and one red fox.

Four positive cases in 2023

In 2023, three out of 98,365 tested wild boars (113,803 wild boars were tested in 2022) and one out of 88 tested red foxes were positive for *Trichinella.* This is the combined result from all laboratories that perform this analysis and includes both SVA and private laboratories.

Other wildlife species tested for *Trichinella* in 2023 include 348 bears, 20 beavers, five badgers, three barn owls, 20 lynx, seven seals, and five wolves. All analyses were negative.

The results show that *Trichinella* is still sporadically detected in wildlife in Sweden. An animal carrying *Trichinella* can cause serious disease in humans if the wild meat is handled incorrectly. Any animal that preys on small rodents or scavenges *Trichinella*-infected meat can become infected with *Trichinella* larvae and then become a carrier of the parasite in its own muscles. Humans can be infected by eating meat with *Trichinella* if the meat has not been heated sufficiently, ta a core temperature of close to 70°C. There are some species of *Trichinella* that are resistant to freezing, so freezing meat is not a safe way to prevent *Trichinella* infection.

Wild boar and brown bear shot during hunting must be tested for *Trichinella* if the carcass is to be sold. This provides surveillance of *Trichinella* infection in these game populations, and their combined population ranges cover most of the country. However, there are different species of Trichinella, and not all are found in all different game species. SVA is one of several laboratories that carry out *Trichinella* testing. However, if *Trichinella* is found in another laboratory, the sample must be sent to SVA, Sweden's veterinary reference laboratory. Typing of the *Trichinella* species is then done at the EU reference laboratory in Italy.

SUID DISEASE SCREENING

In 2023, 241 samples were analysed for classical swine fever virus and 242 samples for Aujeszky's disease (pseudorabies virus) from hunter wild boar. All samples and analyses were negative.

Keep Sweden free from contagious diseases
In addition to the wild boar that come to SVA for testing for African swine fever and salmonella, SVA receives blood samples from hunter harvested wild boar, thanks to helpful hunters. The blood samples are tested for serious infectious pig diseases. They contribute to the surveillance of diseases that Sweden wants to be able to demonstrate freedom from. This has important economic and trade implications.

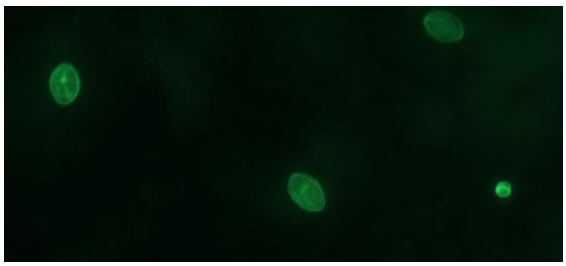
Wild boar (farmed). Photo: Erik Ågren, SVA

ROE DEER DIARRHOEA

In 2023, SVA started a project to investigate the cause of diarrhoea in deer. At SVA, we regularly receive reports of deer with loose faeces. In our current research project, we are investigating whether *Cryptosporidium* can be one of the causes of intestinal inflammation and diarrhoea in deer.

Cryptosporidium species are single-celled parasites that infect the intestinal mucosa and can cause diarrhoea. Cryptosporidiosis affects several animal species and humans, but the prevalence in Swedish deer is unknown. The parasite causes different degrees of disease in different individuals depending on their overall health status. Most affected individuals recover within a couple of weeks. Recurrent outbreaks of cryptosporidiosis in humans are sometimes seen, often linked to leafy vegetables, but the source of the infection rarely is found. Deer are often present in vegetable crops and it therefore is of interest to investigate whether deer can carry the parasite and thus be a possible source of infection.

In 2023, the public submitted 25 faecal samples from deer with diarrhoea and eleven dead deer with intestinal inflammation and diarrhoea.



Giardia *(three larger, slightly elongated organisms) and a* Cryptosporidium *(smaller round on the right) are both single-celled parasites that live in the gut and can cause diarrhoea and intestinal inflammation. Fluorescence microscopy image, SVA.*

We also analysed 48 samples from deer with intestinal inflammation from SVA's biobank, collected between 2013 and 2023. The analyses of these samples are ongoing but preliminary results show that 15 of the deer carried *Cryptosporidium*. Another single-cell parasite, *Giardia*, was identified in 13 roe deer. Of the faecal samples submitted from deer with diarrhoea, 28% were positive for *Cryptosporidium* and 20% for *Giardia*. These results suggest that the diarrhoea in some deer may have been caused by these parasites but does not explain all cases of deer diarrhoea.

The project is funded by the Swedish Environmental Protection Agency and the Ivar and Elsa Sandberg Foundation and will continue in 2024.

NO DETECTION OF SARS-CORONAVIRUS-2 IN ROE DEER

A research project in 2023 studied the presence of SARS-CoV-2 virus in retropharyngeal lymph nodes from Swedish roe deer necropsied at SVA from 2018-2021 i.e. before and during the pandemic. The aim was to see if roe deer were infected and could be a reservoir for the virus. All 110 samples were negative for the virus.

The study was done because roe deer are closely related to white-tailed deer, a species found in North America where there have been cases of humans infecting white-tailed deer with covid (SARS-CoV-2). The virus then spread between deer, which act as a reservoir for the virus, and could potentially be a source of new virus variants. The project was funded by the Swedish Environmental Protection Agency.

CWD-SURVEILLANCE

SVA and the Swedish Board of Agriculture continue to monitor CWD in cervids, with a focus on suspected cases. No new CWD-cases were found during 2023.

Surveillance of clinical cases

The national surveillance of CWD continues, but from 2022 onwards, it focuses only on suspected clinical cases. These are adult cervids with two or more of the following clinical signs that may indicate CWD: emaciation, neurological symptoms, behavioural changes, increased salivation, and increased urination. Dead, emaciated cervids may also be examined if there is no other obvious cause for the emaciation.

If you find a suspected case, contact the SVA wildlife section for instructions!

Result of surveillance 2023

In 2023 all 41 suspected cases in moose, two roe deer and on fallow deer were all negative.

Foto: Erik Ågren

ABOUT CWD

Chronic Wasting Disease is caused by prions, which are infectious proteins. The body's own normal prion protein changes its structure by these prions, turning them into pathogenic prions. The new prions clump together, and as the body is unable to break down the prions, the prion aggregations grow over time cause more and more damage to the brain. CWD is fatal and there is no cure or vaccine.

In North America and in wild reindeer in Norway, CWD is contagious and the disease spreads in populations. Prions survive in the environment where deer graze.
However, the variant of CWD found in old moose and red deer in the Nordic countries is considered to be a variant of CWD that is expected to be non-contagious or have limited contagiousness. It is currently referred to as a sporadic variant. In these animals, prions are found only in the brain, not in lymph nodes or other tissues as seen in the contagious CWD.

EU surveillance 2018 - 2021
In 2017, the European Commission mandated CWD surveillance for the six Member States that have moose or reindeer. Each country had to test at least 6 000 cervids between 2018 and 2021. Since 2018, four positive moose have been detected in Sweden, three older moose cows in Norrbotten and one older moose cow in Västerbotten.

For more information on the disease, see **cwd.se**

R&D

Research and Development, collaborative projects 2023

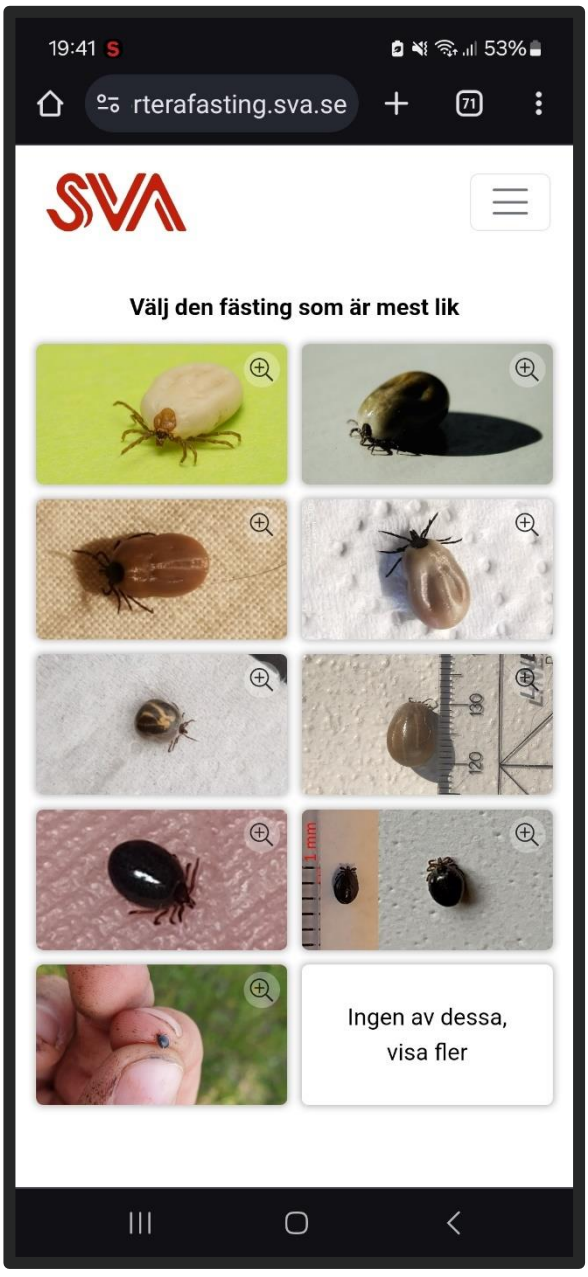
IDALERT

IDAlert (idalert.eu) is an EU project involving a consortium of European wildlife research institutions and aims to increase the ability to manage health risks from infectious diseases in Europe.

Reporting ticks app

SVA contributes to one of the project's work packages by developing Report Tick, a web-based form that lets the public to report when and where they have found a tick. When someone finds an unusual tick not normally seen in Sweden, SVA receives the specimen for screening of infectious agents the tick may be carrying. The app was launched in May 2023 on SVA's website with much media attention. The public interest in ticks is high!

The public has been very active and helpful. Between May and December 2023, over 20,000 ticks were reported! These were mainly the Castor bean tick *(Ixodes ricinus*), but also four cases each of both the Ornate cattle/dog tick (*Dermacentor reticulatus*) and the Brown dog tick *(Rhipicephalus sanguineus*), as well as five cases of both the Mediterranean Hyalomma tick (*Hyalomma marginatum*) and the Red sheep tick (*Haemaphysalis punctata*).



Report a Tick (Rapportera Fästing), an online form where the public can report ticks. This helps SVA map where and when unusual tick species appear in the country and what serious infections they may carry.

ENETWILD 2.0

EnetWild (www.enetwild.com) is a EU project with a consortium of European wildlife research institutions developing methods to better understand and manage potential transmission of infections between wildlife and domestic animals, or humans. In 2023, SVA participated in a literature study on avian influenza in mammals and provided data on the wild boar population from the *Viltdata* database (Swedish Assoc. for Hunting & Wildlife Management).

IMPROVING THE GENERAL WILDLIFE DISEASE SURVEILLANCE – WHO CONTRIBUTES, AND WHY?

How can we improve the general wildlife disease surveillance? A multidisciplinary research project involving both veterinarians and behavioural scientists has been investigating this since 2021.

Focus group discussions with different categories of the public who have submitted wildlife cases to SVA at least twice, and a questionnaire for those who reported wildlife cases to the online reporting form rapporteravilt.sva.se, were carried out in 2022 - 2023. The results are included in the project *Who reports dead or sick wild animals and why?* and what factors affect the submission of cases or samples to SVA.

In 2021, the project mapped all wildlife cases received over the past ten years to analyse which animal species were submitted and where they were found. The goal is to improve and develop the general wildlife disease surveillance to improve programme results which inform decision-making for wildlife managers. The project will be finalised in 2024 and is run by wildlife pathologists and epidemiologists at SVA, and behavioural scientists at Lund University.

Sweden's wildlife disease surveillance at SVA is based on general disease surveillance with investigations of dead or euthanised sick wildlife. The data generated depends on voluntary reporting and the help of the public in submitting carcasses from the field to SVA. By identifying factors that influence sample selection and understanding the demographics and motivation of those who voluntarily report and submit samples, we will gain knowledge on how to facilitate sample submission and increase public engagement. The project is financed by both the Swedish Wildlife Conservation Fund and the Swedish Association for Hunting and Wildlife Management.

General surveillance

Fallen wildlife are found dead or euthanised sick wildlife cases that are examined to determine cause of death. Animals killed by vehicles usually are not included, even if this type of trauma unfortunately is a major cause of death for our wildlife.

GARDEN WILDLIFE HEALTH

The Garden Wildlife Health initiative is a part of general wildlife disease surveillance. The aim is to collect reports and cases of fallen wildlife from the whole country from wildlife living in close proximity to humans, often in urban environments. In an increasingly urbanized world, gardens provide important areas to support biodiversity. With this network of members from all counties and many municipalities we have a broader overview of health and disease issues in wildlife and improved ability to detect increased disease and mortality events in wildlife.

In 2023, the Garden Wildlife Health initiative focused on developing tools to visualize where members are reporting from and which animals they are reporting. These tools will make it easier to detect when and where reports have increased. It also helps us see where gaps in program coverage are and where we need to recruit new members.

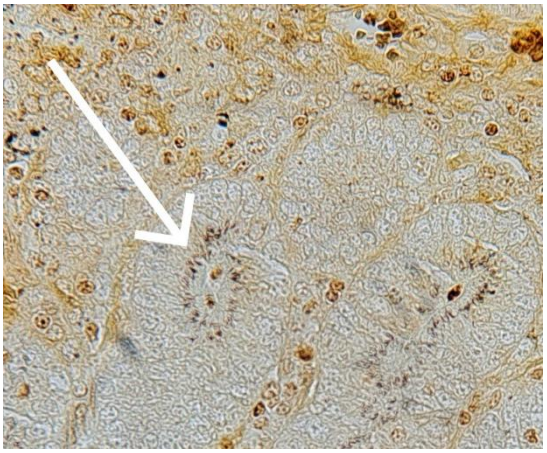
Summarizing and analysing submitted reports and cases allow us to follow-up with targeted surveillance and sampling and inform the general public about the status of the disease or health issue. Another aim of the initiative is to receive information and samples from species that are underrepresented such as reptiles and amphibians. Large knowledge gaps still remain regarding the health and disease status of these small or cryptic species.

To report sick and dead wildlife observed in your garden, go to *Vilthälsa inpå knuten* on SVA's website.

LAWSONIA IN A WILD BOAR

An interesting wildlife case from the fallen wildlife surveillance 2023 involved a yearling wild boar. It was found dead in Falkenberg municipality and sent to SVA for examination.

The main finding was severe intestinal change. The mucosa of the small intestine was severely thickened and oedematous, and haemorrhage was seen in both the colon and small intestine. Microscopy revealed suspected *Lawsonia* bacteria in the intestinal mucosa. Bacterial analysis confirmed *Lawsonia intracellullaris* which is a very rare finding in wild boar in Sweden. In domestic pigs, this bacterium can cause chronic intestinal disease, usually affecting young piglets. The diarrhoea typically is watery and greyish-brown, but more acute forms of the disease with bloody diarrhoea and sporadic death can affect older pigs. This form is called proliferative haemorrhagic enteropathy.



Microscope image of intestinal mucosa with colonies of small elongated dark 0,0015 mm Lawsonia intracellularis *bacteria inside intestinal epithelial cells.*

Marine mammals

In total, 43 harbour porpoises and 22 seals were examined during 2023. A limited number of marine mammals are examined each year. This necessitates a long-term surveillance programme to accumulate enough cases over time to monitor trends regarding health, diseases, and causes of death.

A dead porpoise in the necropsy room at SVA. It is undergoing external examination to collect biologic data before the necropsy. Different body measurements are taken, and external lesions are documented. Photo: SVA

HEALTH AND DISEASE SURVEILLANCE

Since 2020, the Swedish Veterinary Agency (SVA) delivers a health and disease surveillance program for marine mammals together with the Swedish Museum of Natural history (NRM). The program is financed by the Swedish Agency for Marine and Water Management and a part of Sweden's environmental monitoring.

The surveillance program includes all stranded (found dead with unknown cause of death) and bycaught (unintentionally caught in fishing nets) cetaceans (whale animals) and stranded seals.

SVA and NRM collect data to monitor when and where marine mammals die. Suitable animals are collected and transported to SVA for examination and sampling. We investigate health status, diseases and causes of death, which contributes to knowledge of these species.

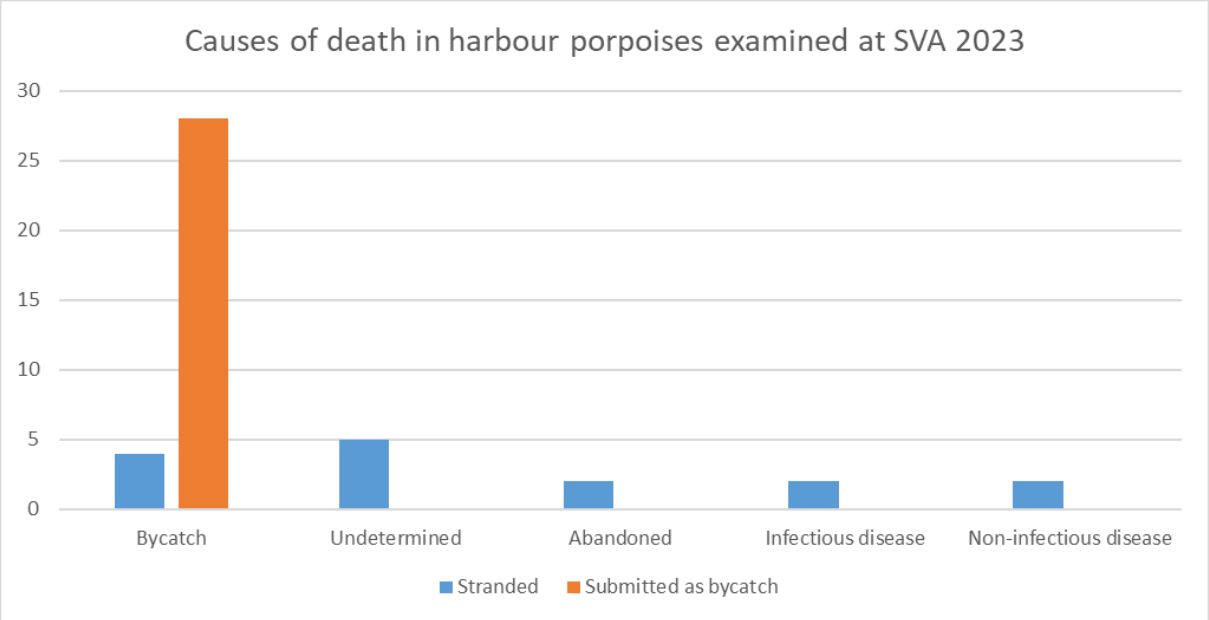
In total, 68 marine mammals were examined at SVA during 2023; 43 Harbour porpoises, eight Grey seals, one Ringed seal and 13 Harbour seals. An additional 89 samples from hunted seals and one Ringed seal examined at NRM were analysed for influenza A virus. Other examined whales included a Common dolphin (*Delphinus delphis*), a White-beaked dolphin (*Lagenorhynchus albirostris*) and a killer whale (*Orcinus orca)*. Samples from another dead Orca were also tested for influenza virus. For more details, see our annual report "Health, diseases and causes of deaths in marine mammals 2023" at **sva.se**

CETACEANS

Harbour porpoises

Amongst the 15 stranded porpoises, four died from bycatch diagnosed by net marks and signs of drowning. The same signs could be seen on the 28 bycaught porpoises submitted by fishermen. Linear impressions and small cut marks (net marks) were seen on the head, flippers, dorsal fin and flukes.

Large airways were often filled with frothy fluid, a common finding in drowning cases. Some cases also showed hemorrhages and internal trauma. Skin lesions were commonly seen. Some were consistent with Pox virus and bacteria and fungi were found in others. Parasites are commonly seen, with 13 porpoises having moderate to severe parasite infestations in one or more organs.



Overview of the primary diagnoses (causes of deaths) in Harbour porpoises examined in 2023.

Other whales 2023

Common dolphin

A stranded Common dolphin was observed in March, in Båstad. In addition to parasites in the mammary glands, the dolphin had a bacterial infection (mastitis) that spread through the body (sepsis). The bacteria *Streptococcus phocae* was the cause of the infection.

White-beaked dolphin

A live, White-beaked dolphin stranded outside Ängelholm and died shortly afterwards. No clear cause of the stranding was found during necropsy.

Orca

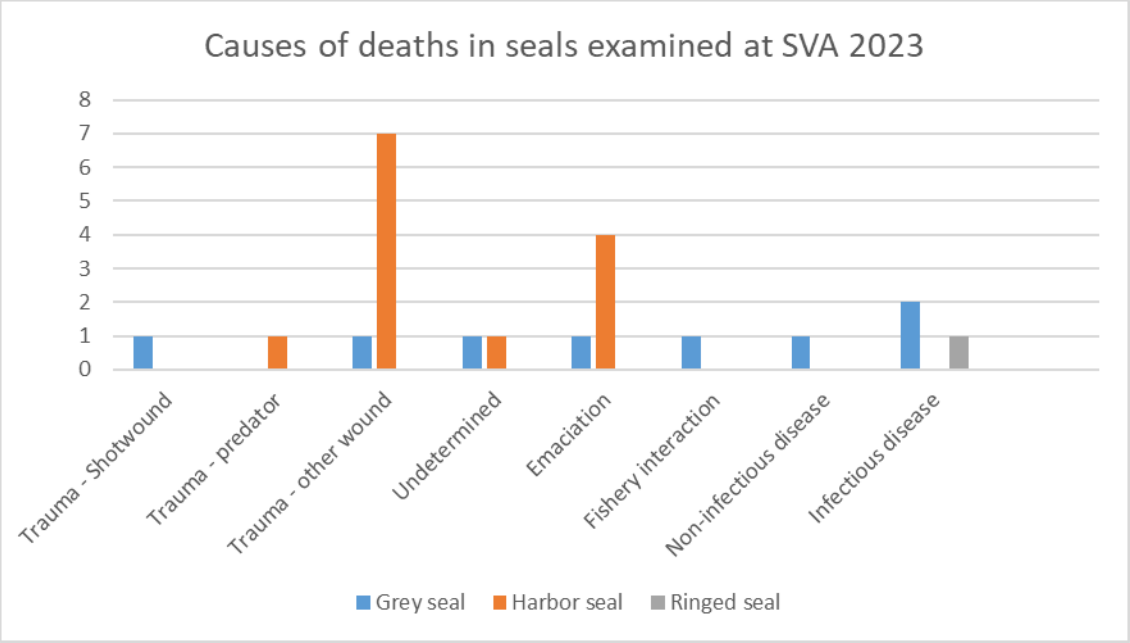
A dead Orca found and reported in May in Sotenäs on the west coast. The male orca was examined in the field and was determined to have died of emaciation following severe tooth wear. The pulp was visible in some teeth. The orca was only 18-19 years old, a relatively young individual since male orcas can reach 30-40 years of age.

The orca was a young male with severe tooth wear. The orca was examined in the field by staff from SVA.

SEALS

The most common cause of death in seals was some sort of injury (trauma) seen in eight Harbour seals and two Grey seals. Emaciation also was common and seen in five pups. Most of the individuals that died of trauma and emaciation were young pups. Other causes of death in Grey seals included fishery interaction (perforation of intestines due to swallowed fishing gear), emaciation and diseases. The examined Ringed seal had a severe infestation of liver flukes which caused liver failure. In two seals, no diagnosis could be determined but one of the carcasses was in very bad condition.

Two findings of antibodies against Influenza A Virus were found in cadaver blood from grey seals that were bycaught and hunted in 2023. Antibodies against Influenza A virus was also found in a stranded grey seal that was euthanized because of acute torsion of the intestines, and in one harbor seal with bacterial pneumonia. These findings suggest that these animals have been exposed to, and survived, the infection. The bacterial pneumonia was caused by *Streptococcus phocae*. The same bacteria were also found in the lungs of two other seals that died from other reasons.



Overview of the primary diagnoses (causes of deaths) in the seals examined at SVA 2023.

Large carnivores

SVA receives all large carnivores - brown bear, lynx, wolf, and wolverine that are found dead, culled, or killed during hunting, either as carcasses or as samples. This is financed by the Swedish Environmental Protection Agency as part of the management of these protected species. The number of large carnivores examined at SVA has increased by 113% in five years, due to increased licensed hunting, as populations have increased.

In 2023, SVA handled whole carcasses or parts from 1,165 large carnivores. The majority of whole carcasses submitted are either killed during licensed hunting or killed during other wildlife management-related measures. The second most common cause of death is vehicular collision, either on the road or railway. The most commonly noted disease in some large carnivores is mange, which usually leads to emaciation of the affected animal. Forensic investigations are performed in cases of suspected hunting crimes.

SVA handles parts and whole carcasses from these large carnivores on behalf of the Swedish Environmental Protection Agency as part of the national management of the large carnivore populations. The Swedish Environmental Protection Agency's regulations NFS 2002:18 § 42 state that dead animals or animal parts of these species that are found must be reported to the police authority, which in turn delivers them to SVA for examination.

When large carnivores are killed during protective or licensed hunting, the carcass normally belongs to the hunter that has the hunting rights or the landowner. However, it is usually mandatory in the county administrative board decision to hunt the animal that certain parts or samples must be sent to SVA.

Table with number of carnivores that have arrived at SVA per year, for the period 2019–2023, as whole carcasses, part of carcasses, or samples. Source: SVALA and SVA annual report 2022.

Species	2019	2020	2021	2022	2023
Bear	377	444	596	737	767
Lynx	144	168	168	186	271
Wolf	28	31	57	49	91
Wolverine	11	30	16	15	36
Total	**560**	**673**	**837**	**987**	**1165**

The examination of large carnivores performed at SVA is an important part of monitoring the health status of these populations. With continuous monitoring over a long time period, variations in diseases and causes of death can be investigated and trends can be detected.

Causes of death and health status of the bears, wolverines, lynx, and wolves that have been examined at SVA in 2023 are summarized in the table below. More details are published in SVA's report - Large Carnivore 2023, as well as in the reports published after each licensed hunt for wolf, lynx, wolverine and bear, which can be found on SVA's website sva.se.

Table with the number of submitted carnivores from 2019–2023. Source: Annual reports - Large carnivores 2019–2023.

Cause of death		2019	2020	2021	2022	2023
Licensed hunting	Bear	297	284	463	623	643
	Wolf	-	-	27	28	57
	Lynx	68	93	81	106	182
	Wolf.	-	-	-	-	22
	Total	**365**	**377**	**571**	**757**	**904**
Protective hunting (Incl. §28)	Bear	41	144	111	87	92
	Wolf	16	20	18	14	25
	Lynx	19	29	26	25	25
	Wolf.	10	25	13	9	7
	Total	**86**	**218**	**168**	**135**	**149**
Found dead - killed in traffic	Bear	11	8	10	15	15
	Wolf	9	8	6	7	3
	Lynx	34	33	42	35	48
	Wolv.	1	1	2	2	1
	Total	**55**	**50**	**60**	**59**	**67**
Found dead - other cause of death	Bear	2	2	1	4	5
	Wolf	4	3	5	-	-
	Lynx	10	8	14	9	7
	Wolv.	-	4	-	4	1
	Total	**16**	**17**	**20**	**17**	**13**
Forensic case	Bear	14	1	5	4	5
	Wolf	-	-	2	1	4
	Lynx	3	-	-	2	-
	Wolv.	-	-	1	-	3
	Total	**17**	**1**	**8**	**7**	**12**

BROWN BEAR

767 whole carcasses or parts of bears were submitted to SVA in 2023, a majority from licensed or protective hunting. Three bears were killed in self-defense. Fifteen bears were killed in traffic and four bears were killed by predators. One bear cub had drowned, and five bears were submitted as forensic cases. During the necropsies, some older or fresh naturally occurring injuries also were found. Other findings, such as malformations, parasites and impaired dental health, also were noted. Based on these examinations, is the bear population assessed to be in good health.

WOLVERINE

36 wolverines were received during the year, of which nine were from protective hunting and 22 from licensed hunting (15 wolverines were killed during licensed hunting in 2022 but arrived at SVA in 2023). One animal had been killed in road traffic and one was euthanized because it got caught in a marten trap. Moderate tooth wear and some missing and fractured incisors were noted in one wolverine. However, this individual was in good body condition with normally developed musculature. Three wolverines were submitted as forensic cases. The wolverines are assessed to be in good health.

LYNX

271 lynx were received during the year, of which 182 were killed during licensed hunting and 25 during protective hunting. As in previous years, traffic accidents were the most common cause of death for animals found dead. Some secondary findings were noted during the necropsies. Two lynx had a small extra adrenal gland and two males had only one testicle in the scrotum. Four lynx had mange, two of which had starved to death. Mange is still the most common severe infectious disease in this population. The state of health is however considered to be good.

WOLF

91 wolves arrived at SVA during the year, primarily from licensed or protective hunting. Three of the other wolves died in traffic. Other necropsy findings included older, healed fractures of the skeleton. Three males were cryptorchid. A few individuals had minor malocclusions or tooth defects. Tapeworm (*Echinococcus granulosus)* has not been detected in any of the sampled wolves. Based on the examined and necropsied individuals, the wolf population considered to be in good health.

Wolverine. Photo: Pixabay

Wildlife disease surveillance at SVA

The government's instruction to SVA (2009:1394) states that the veterinary expert authority shall monitor and analyse the disease status of wildlife in Sweden.

SVA is the only veterinary laboratory in the country that systematically works with disease surveillance of wild animals. The work is mainly based on necropsies of dead wildlife carcasses or samples from sick euthanized animals. Reports of found dead or sick wild animals are collected from the public and appropriate cases are submitted for examination. This citizen science is complemented by early warning monitoring to be prepared for disease outbreaks in wildlife and initiate targeted surveillance. Research projects are done to further the knowledge of diseases or to develop new diagnostic tools for wildlife species. This report presents activities and results of the wildlife work at SVA in 2023.

Bat found injured in daytime. The most common cause of death in bats are predation by cats. Photo: Ulrika Larsson Pettersson, SVA.

The targeted wildlife disease surveillance programme was initiated in 2006 in cooperation with the Swedish Environmental Protection Agency (EPA) to finance additional wildlife studies, mainly targeted disease surveillance.

The Wildlife Disease Council (*Viltsjukdomsrådet*) is a group of experts and officials from the Swedish EPA and SVA. The council discusses wildlife health issues and jointly recommends targeted initiatives for SVA to carry out during the year. In 2023, the Council consisted of Klas Allander, Eleonor Glad and David Schönberg-Alm from the EPA, and Dolores Gavier-Widén, Erik Ågren, and Aleksija Neimanis from SVA. Henrik Uhlhorn, SVA serves as secretary. In 2023, the council held two meetings.

Finances

The wildlife work is financed mainly by grants from the Swedish Game Management Fund (*Viltvårdsfonden*), the Swedish Environmental Protection Agency, Government funding, the Swedish Agency for Marine and Water Management, and project funding from the Swedish Board of Agriculture.

The Game Management Fund is based on the annual state game conservation fee that each person participating in hunting in Sweden must pay. SVA received 5 million SEK in 2023. As this funding originates from hunters, focus is on game species, but all wild mammals, birds, amphibians, and reptiles are included in the overall work.

Government grants
Wildlife disease surveillance at SVA is facilitated by the expertise and infrastructure already in place to carry out veterinary diagnostics for domestic species.

The Swedish Board of Agriculture may provide grants for specific studies of selected reportable animal diseases. The purpose is to monitor the occurrence of a specific disease or pathogen in wildlife, or to monitor wildlife to show freedom from a specific disease. In 2023, funding was given for monitoring Echinococcus, avian influenza, Trichinella, as well as salmonella and African swine fever in wild boar.

The Swedish Environmental Protection Agency (EPA) funds the work with large carnivores. In addition, the EPA funds current targeted surveillance projects such as investigations of ongoing disease outbreaks or increased wildlife mortality, and establishment of specific laboratory analytic methods for wildlife samples.

The Swedish Agency for Marine and Water Management finances the work with health and disease surveillance of marine mammals done at SVA and at the Museum of Natural History. This work contributes to the national environmental surveillance. Results of necropsies are published openly, and data and samples are collected for biobanks and research.

Wildlife staff

The wildlife work is mainly done at the Department of Pathology and Wildlife Diseases (POV).

The work is based on pathological examination of wildlife, but other departments and laboratories throughout SVA are involved with ancillary testing and analyses of infectious agents and chemical substances, or with epidemiology. Collaboration with external wildlife researchers at Swedish University of Agricultural Sciences (SLU) and other national or international institutes is also an important part of the work with wildlife.

Section of Wildlife 2023

Erik Ågren Deputy head of Department, Head of section, Veterinary Officer, Dipl. ECVP, DipECZM (Wildlife population health). WOAH National Focal point for wildlife diseases.
Henrik Uhlhorn Veterinary Officer, PhD
Karin Olofsson-Sannö Veterinary Officer, PhD
Gustav Averhed Veterinary Officer
Elina Thorsson Veterinary Officer, Resident ECZM (Wildlife population health)
Emma Höök Agronomist, biologist for Large carnivore group
Marit Liljefors Technician

Section of Research and Development 2023

Aleksija Neimanis Head of section, State veterinarian, Ass. professor, MSc, MVetSci, PhD, DipACVP
Caroline Bröjer State veterinarian, MSc, PhD, DipECZM (Wildlife population health)
Ellinor Spörndly-Nees, Deputy State veterinarian, PhD
Ulrika Larsson Pettersson Biomedical engineer
Emil Wikström-Lassa Laboratory veterinarian, PhD student
Moa Naalisvaara Engman, Marine biologist

Other involved staff within the department

Administrators Carina Bohlin, Julia Tibell, Christina Rosander. Necropsy assistants Hans Kanbjer, Johan Karevik, Lars Hammarsten. Technicians Sandra Karevik, Katarina Jendelöv, Benny Eriksson, Anders Åslund. Biomedical analysts Gudrun Andersson, Shaqe Hafstad, Mariam Kerro, Angelica Stefansdotter. Dolores Gavier-Widén, head of department.

Publications 2023

Here we list wildlife publications with authors from the Wildlife section or other departments at SVA, these names are in bold.

SCIENTIFIC PUBLICATIONS, SELECTION

Knauf S, Hisgen L, **Ågren EO**, Barlow AM, Faehndrich M, Voigt U, Fischer L, Grillová L, Hallmaier-Wacker LK, Kik MJL, Klink JC, Křenová J, Lavazza A, Lüert S, Nováková M, Čejková D, Pacioni C, Trogu T, Šmajs D, Roos C. High prevalence and genetic diversity of *Treponema paraluisleporidarum* isolates in European lagomorphs. Microbiol Spectr. 2023 Dec 14:e0177423.

Axnér E, Cederlund E, **Ågren EO**, Dalin AM. Characteristics of reproductive organs and reproductive potential in Scandinavian female grey wolves (Canis lupus). Anim Reprod Sci. 2023 Aug;255:107266.

Sola D, Tran L, Våge J, Madslien K, Vuong TT, Korpenfelt SL, **Ågren EO, Averhed G, Nöremark M**, Sörén K, Isaksson M, Acín C, Badiola JJ, **Gavier-Widén D**, Benestad SL. Heterogeneity of pathological prion protein accumulation in the brain of moose (Alces alces) from Norway, Sweden and Finland with chronic wasting disease. Vet Res. 2023 Sep 8;54(1):74.

Meurling S, Siljestam M, Cortazar-Chinarro M, Åhlen D, Rödin-Mörch P, **Ågren E**, Höglund J, Laurila A. Body size mediates latitudinal population differences in the response to chytrid fungus infection in two amphibians. Oecologia. 2023 Dec. 14.

Naguib, M. M., Eriksson, P., Jax, E., Wille, M., Lindskog, C., **Bröjer, C**., Krambrich, J., Waldenström, J., Kraus, R. H. S., Larson, G., Lundkvist, Å., Olsen, B., Järhult, J. D., & Ellström, P. (2023). A Comparison of Host Responses to Infection with Wild-Type Avian Influenza Viruses in Chickens and Tufted Ducks. *Microbiology spectrum*, *11*(4), e0258622. https://doi.org/10.1128/spectrum.02586-22

Skog, E., Nykvist, M., Naguib, M. M., Wille, M., **Bröjer, C**., Agarwal, V., Ellström, P., Westman, G., Lundkvist, Å., & Järhult, J. D. (2023). An oseltamivir-resistant avian H1N1 influenza A virus can transmit from mallards to chickens similarly to a wild-type strain: implications for the risk of resistance transmission to humans. *The Journal of general virology*, *104*(4), 10.1099/jgv.0.001835. https://doi.org/10.1099/jgv.0.001835

Spörndly-Nees E, Uhlhorn H, Jinnerot T, Neimanis A. *Chlamydia psittaci* in garden birds in Sweden. One Health. 2023 Apr 17;16:100542. doi: 10.1016/j.onehlt.2023.100542.

Thorsson, E., **Zohari, S**., Roos, A., **Banihashem, F**., **Bröjer, C**., & **Neimanis, A**. (2023). Highly Pathogenic Avian Influenza A(H5N1) Virus in a Harbor Porpoise, Sweden. *Emerging infectious diseases*, *29*(4), 852–855. https://doi.org/10.3201/eid2904.221426

Lean, F. Z. X., Cox, R., Madslien, K., Spiro, S., Nymo, I. H., **Bröjer, C**., **Neimanis, A**., Lawson, B., Holmes, P., Man, C., Folkow, L. P., Gough, J., Ackroyd, S., Evans, L., Wrigglesworth, E., Grimholt, U., McElhinney, L., Brookes, S. M., Delahay, R. J., & Núñez, A. (2023). Tissue distribution of angiotensin-converting enzyme 2 (ACE2) receptor in wild animals with a focus on artiodactyls, mustelids and phocids. *One health (Amsterdam, Netherlands)*, *16*, 100492. https://doi.org/10.1016/j.onehlt.2023.100492

Björn Herrmann, Rachid Aaziz, Rene Kaden, Hilde M. Riedel**, Ellinor Spörndly-Nees**, Lisa Labbé Sandelin, Karine Laroucau. SNP-based high-resolution typing of Chlamydia psittaci from humans and wild birds in Sweden: circulation of the Mat116 genotype reveals the transmission mode to humans, Microbes and Infection, Volume 26, Issue 3, 2024, 105251,ISSN 1286-4579, https://doi.org/10.1016/j.micinf.2023.105251.

Ernholm, L., **Ståhl, K**., **Neimanis, A**., **Widgren, S.** and Sternberg-Lewerin, S., 2023. Understanding the interface between European wild boar (Sus scrofa) and domestic pigs (Sus scrofa domesticus) in Sweden through a questionnaire study. *Acta Veterinaria Scandinavica*, *65*(1), p.40.

REPORTS AND POPULAR SCIENCE PUBLICATIONS

SVA annual report 2022. Wildlife [Swedish]. **E. Ågren**

Surveillance of infectious diseases in animals and humans in Sweden 2022. Postmortem examinations in wildlife, **E. Ågren**. Tularaemia, **H. Uhlhorn.**

Wildlife disease surveillance in Sweden 2022. SVA report 86/2023. Editor: Erik Ågren

Health, disease, and causes of death in marine mammals 2022. SVA report 82/2022 [Swedish]. **A. Neimanis, E. Thorsson, N. van de Velde, E. Höök,** Anna Roos

Licensed wolverine hunt 2022 [Swedish]. SVA report 83/2023 [Swedish]. **Emma Höök, Erik Ågren**.

Licensed wolf hunt 2023 [Swedish]. SVA report 84/2023. **Emma Höök, Erik Ågren.**

Licensed lynx hunt 2023 [Swedish]. SVA report 87/2023. **Emma Höök, Erik Ågren.**

Licensed wolf hunt 2023 [Swedish]. SVA report 91/2023. **Emma Höök, Erik Ågren**

Ågren Erik, Johan Lindsjö J., Kjellander P., Alm Bergvall U. 2023. Of mice, and men who catch them. [Swedish]. Swedish veterinary journal [Svensk veterinärtidning] nr 7/23, 46–47.

SVA popular science blog:
Psittacosis is rare in Swedish garden birds [Swedish]. **Ellinor Spörndly-Nees** 2023-06-05

Mass mortality of guillimots due to emaciation [Swedish]. **Ellinor Spörndly-Nees** 2023-06-02

Trichomoniasis continues to affect passerines [Swedish]. **Henrik Uhlhorn** 2023-05-26

No Swedish birds positive for West Nile Fever or Usutu virus [Swedish]. **Ellinor Spörndly-Nees** 2023-05-25

PRESENTATIONS 2023 SELECTION

Avian influenza in poultry and wild birds [Swedish]. Bröjer och Malin Grant. Webinarium for County Administrative Boards, Forum for large birds, 9 February 2023.

Veterinary forensic pathology in Sweden and a European certificate. Keynote speaker Erik Ågren. International Veterinary Forensic Science Association, Phoenix AZ, 11-13 May 2023.

Avian influenza also can infect cetaceans. Aleksija Neimanis. Invited speaker, 19th Jastarnia meeting, ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas). Online, 20-22 mars, 2023.

Current wildlife diseases and 75 years of surveillance. Erik Ågren. Swedish Association for Hunting and Wildlife Management, Kalmar annual meeting 29 March 2023, Högsby.

Current wildlife diseases and 75 years of surveillance. Erik Ågren. Swedish Association for Hunting and Wildlife Management, Kronoberg annual meeting 30 March 2023, Ryssby.

Influenza A virus surveillance and findings in marine mammals in Sweden. Aleksija Neimanis. Invited speaker 'What's new in marine mammal pathology workshop', European Cetacean Society conference, Spain, 17 May 2023.

Fatal infection of Influenza A virus in a harbour porpoise (*Phocoena phocoena*). **Elina Thorsson**, **Siamak Zohari**, Anna Roos**, Fereshteh Banihashem, Caroline Bröjer**, **Aleksija Neimanis**. Poster presentation, European Cetacean Society conference, Spain, 17 May 2023.

Current wildlife diseases and 75 years of surveillance. Erik Ågren. Coastal hunting seminar, Swedish Association for Hunting and Wildlife Management, Öster Malma 2 May 2023.

NWDA conference, Oscarsborg Norway, 22-24 May 2023. Nine presentations on Swedish wildlife health, such as:

Wildlife disease surveillance Sweden 2021-2022. Erik Ågren.

Avian Influenza surveillance Sweden 2021-2023. Caroline Bröjer.

Tularemia, more common than we previously thought? Sweden 2021-2023. Ellinor Spörndly-Nees.

Who sends fallen wildlife to SVA and why? Aleksija Neimanis.

Findings from Sweden's marine mammal health and disease surveillance program. Aleksija Neimanis.

Current diseases in wild boar. Erik Ågren. County Administrative Board Uppsala Wild boar project. SVA 14 september 2023.

African swine fever in Sweden 2023. Erik Ågren. Swedish Association for Hunting and Wildlife Management Västmanland, Västerås 13 September 2023.

African swine fever in Sweden 2023. Erik Ågren. Visitors from the Ministry of Rural affairs and Infrastructure, SVA 13 October 2023.

Citizen science and wildlife disease surveillance. Aleksija Neimanis. Invited speaker, SVA Research Day, Uppsala 14 November 2023.

Moose health then, now, and the future. General wildlife disease surveillance 75 years. Erik Ågren. Sveriges Vildnad, Öster Malma 26 Nov 2023.

Wildlife section in media

Social media

33%

The Wildlife sections´share of SVA total Social Media publications 2023.

256 000

Social media possible outreach (Facebook and Instagram)

18 000

Social media interactions (Facebook and Instagram)

Other media

10 265

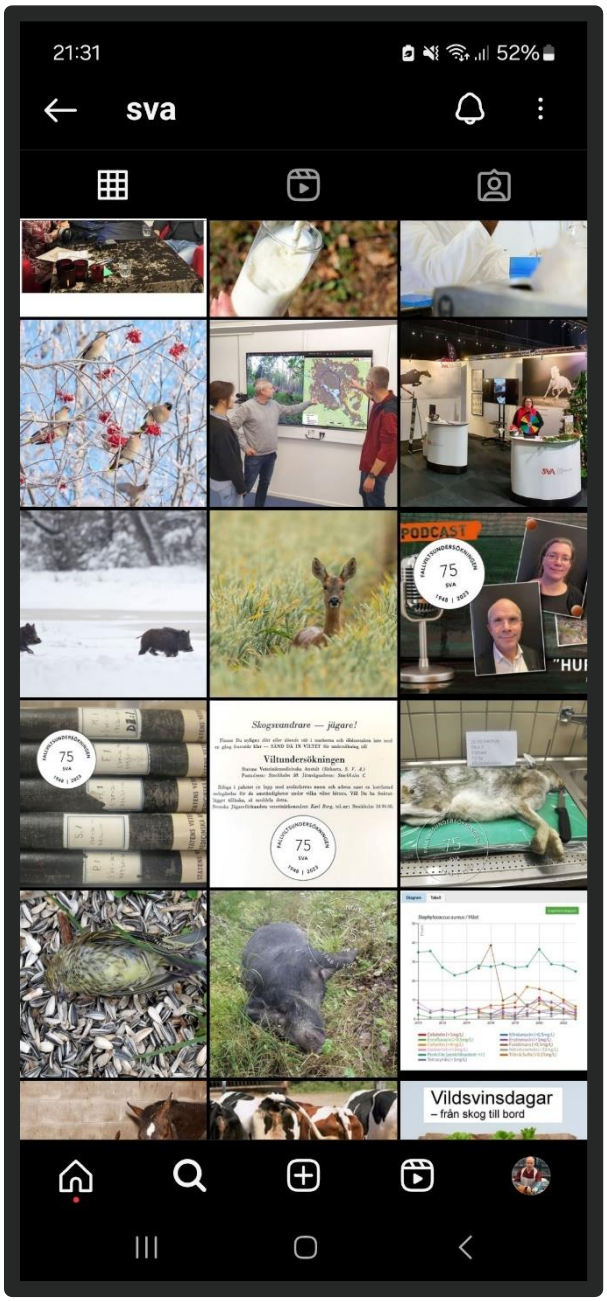
...articles concerning SVA and wildlife

VISITORS TO THE WILDLIFE SECTION

Large Carnivore Association - Rovdjursföreningen 15 mars 2023
Ministry of Rural Affairs and Infrastructure 13 okt 2023.
Police forensic technicians, 30 oktober 2023.
Swedish Deer farmers´ Association, 4 nov 2023.

PODCASTS

Swedish Association for Hunting and Wildlife Management podcast *På jakt*. Episode #13 How is the health of wildlife? **Erik Ågren** and Bodil Elmhagen.



Instagram: SVA

Outreach

COURSE INSPECTION OF LARGE CARNIVORES

In June, the annual course for inspectors was held at SVA together with the organiser Viltskadecenter (SLU). The aim of the course is for the County Administrative Board's inspectors to learn the practical and administrative aspects of inspecting hunter harvested large carnivores, and learning the procedures and regulations involved.

Training in forensic investigations and wildlife crime. Police crime scene technicians.

EXPERT OPINIONS 2023

The Swedish Environmental Protection Agency, National Management Plan for the Great Cormorant.

Ministry of Rural Affairs and Infrastructure, Memorandum on hunters´ possibility to pass on small quantities of wild boar or wild boar meat directly to the final consumer.

GOVERNMENT ASSIGNMENTS 2023

The **Wildlife Conservation Fund** contributes with funds for SVA's task of wildlife disease surveillance. The activities are reported annually with an interim report on 1 October and a final report on 1 April, to the responsible ministry.

The government assignment within the **Wild Boar Package** for SVA; *Prerequisites for digitalised traceability of wild boar meat* was reported in January 2022. The report is available at **sva.se.** In 2023, SVA has continued to participate in the management group and project group for the Wild Boar Package.

Continuing education

TRAINING CENTER FOR WILDLIFE SPECIALISTS

In 2023, the Wildlife Section had one veterinary resident training for the European College of Zoological Medicine (ECZM), Wildlife Population Health speciality.

In 2021, SVA was approved as a training centre for this European specialist training. At the Wildlife Section, there are two Diplomates within ECZM, now responsible for training and supervising residents. The programme is partly financed by the Marie-Claire Cronstedt Foundation. In addition, two veterinarians in the wildlife section also have European and American specialist qualifications in veterinary pathology (ECVP and ACVP respectively).

ECZM
EUROPEAN COLLEGE
OF ZOOLOGICAL MEDICINE

Expert groups

The staff of the wildlife group participated in the following expert groups:

Wildlife Disease Council. Swedish Environmental Protection Agency (EPA) & SVA, SVA-members: Dolores Gavier-Widén, Erik Ågren, Aleksija Neimanis. Secretary: Henrik Uhlhorn.

SVA Wildlife Disease Surveillance Council Gunilla Hallgren, Karl Ståhl, Maria Nöremark, Dolores Gavier-Widén, Erik Ågren, Aleksija Neimanis.

SVA Scientific council Aleksija Neimanis

SVA Environmental and Climate committee Emma Höök

SVA Zoonosis centre working group Henrik Uhlhorn for Dept of Pathology and Wildlife Diseases.

SVA R&D Coordination group Ellinor Spörndly-Nees

SVA expert group African swine fever Erik Ågren

SVA Poultry forum Caroline Bröjer

Hoofed wildlife council (EPA), SVA representant: Gustav Averhed

Swedish Board of Agriculture Wildlife reference group, SVA representative: Erik Ågren

Reference group invasive species (Swedish Association for Hunting and Wildlife Management), SVA representative: Caroline Bröjer

Information central for the Gulf of Bottnia SVA representative: Caroline Bröjer

EWDA, European section, Wildlife Disease Association. Newsletter editor & EWDA Board: Erik Ågren

EWDA Network for Wildlife Health Surveillance in Europe, committee member: Aleksija Neimanis

NWDA, Nordic section of Wildlife Disease Association, Board member: Henrik Uhlhorn

International Wildlife Health Surveillance Working Group; Erik Ågren

ECZM, European College of Zoological Medicine, Wildlife Population Health specialty: Caroline Bröjer *examination committee* and *resident programme director*, Erik Ågren *resident supervisor*

Journal of Wildlife Diseases, associate editors: Erik Ågren, Aleksija Neimanis

WOAH Focal point for wildlife: Erik Ågren

Healthy wildlife – Safe people

The Swedish Veterinary Agency, SVA, is an expert authority that through diagnostics, research and expert advice strengthens the national ability to manage animal diseases that threaten critical functions in society. The motto of SVA is: Healthy animals – Safe people.

SWEDISH VETERINARY AGENCY

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