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Methods and specific information 2024

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Supplement to the Report on Animal Disease Surveillance and Early Detection 2024

Contents

1 Introduction 3

2 Importance and objectives of disease-free status, control and early detection 3

2.1 Demonstrating disease-free status 3

2.2 Control 3

2.3 Early detection 3

3 Demonstrating freedom from disease: general principles 3

3.1 Requirements for freedom from disease 3

3.2 Random sample testing 4

3.3 Farm selection 5

3.4 Laboratory testing 6

4 Demonstrating freedom from disease: disease-specific information 7

4.1 Infectious bovine rhinotracheitis (IBR) and enzootic bovine leukosis (EBL) 7

4.2 Bluetongue disease 10

4.3 Aujeszky's disease (AD) and porcine reproductive and respiratory syndrome (PRRS) 11

4.4 Brucellosis in small ruminants 14

5 Monitoring control: disease-specific information 15

5.1 Bovine viral diarrhoea (BVD) 15

5.2 *Salmonella* infection in poultry 16

6 Early detection of animal diseases: disease-specific information 17

6.1 Low pathogenic avian influenza (LPAI) and Newcastle disease (ND) in commercial poultry 17

6.2 Highly pathogenic avian influenza (HPAI) in wild birds 19

7 General information on animal disease surveillance 19

Supplement to the Report on Animal Disease Surveillance and Early Detection 2024

1 Introduction

Animal disease surveillance serves to record and document the health status of farm animals in Switzerland. Every year the FSVO and cantonal veterinary services use disease-specific surveillance programmes for several animal diseases and zoonoses to document the health status of Swiss farm animals. Official veterinarians take samples from farm animals on behalf of the national veterinary service. Recognised diagnostic laboratories test these samples for pathogens. Depending on the disease and animal species, samples are collected on farms, during milk collection or in slaughterhouses. The results of this surveillance are crucial in deciding whether animal products can be exported or whether control measures need to be adopted or adjusted.

This supplement describes the general methods used in the surveillance programmes and gives information on methodological features specific to each disease.

2 Importance and objectives of disease-free status, control and early detection

Depending on the objective of the programme, it may be appropriate to use different methods. The surveillance programmes carried out in Switzerland pursue three different objectives, depending on the animal disease.

2.1 Demonstrating disease-free status

Animal diseases that have been successfully controlled and eradicated in Switzerland could be reintroduced at any time. Freedom from eradicated diseases has therefore been ensured since 1995 by means of regulations and testing on import. Domestic surveillance is based on two pillars: the investigation of clinically suspected cases and an annual surveillance programme. Freedom from disease is monitored for the following diseases: IBR, EBL, AD, PRRS, brucellosis in small ruminants (*Brucella abortus/B. melitensis/B. suis)*, BSE and ND.

2.2 Control

The control of animal diseases is a protracted process. Its success has to be documented regularly in order to determine any necessary adjustments to the control measures. Control is monitored for the animal diseases BVD and Salmonella in poultry. The control and surveillance measures are disease-specific and are described in Sections 5.1 and 5.2.

2.3 Early detection

The task of early detection is to continuously assess the risks posed by animal diseases and epizootics and to pass on the resulting information to decision-makers in a targeted manner. In the best scenario, the introduction of a disease can be prevented or the risk minimised. But in any case, early detection contributes to risk reduction, including damage limitation. Early detection programmes are carried out for LPAI/ND in domestic poultry (with freedom from ND also being demonstrated) and HPAI in wild birds. Here too, the methods used are disease-specific and are described in the individual sections (6.1 and 6.2).

3 Demonstrating freedom from disease: general principles

3.1 Requirements for freedom from disease

“Demonstration of freedom from disease” relies on random testing, which in turn is based on statistical considerations. If all tests in the random sample are negative, the presence of the disease can be ruled out with a given degree of probability. In demonstrating freedom from disease, this probability is referred to as “confidence” and is expressed as a percentage. The maximum value is 100%. However, it can only be achieved in theory, as this would require all units of the population to be examined with a perfect test. However, 99% confidence can be achieved even with small sample sizes.

Freedom from disease is generally demonstrated on an annual basis. In order to demonstrate freedom from an animal disease, there must be no prior evidence that the disease is present in the area concerned. Such a condition can only be met if there is an obligation to investigate cases of disease and suspected cases and to report them to the relevant authorities. If there is also a risk of the disease being

introduced, this must be communicated, and awareness of the disease must be raised so as to enable suspected cases to be identified: animals showing typical clinical signs of the disease must be examined accordingly.

If there is no evidence that the disease in question is present in Switzerland, the requirements for statistically based demonstration of disease-free status are met by means of random sampling. For some diseases, bilateral treaties with the EU stipulate that disease-free status must be demonstrated in order to export animals and derived products to EU countries which also have disease-free status. Disease-free status also authorises countries to regulate the import of animals and animal products. Demonstrating freedom from disease therefore has economic advantages. Switzerland therefore demonstrates its freedom from disease "voluntarily" in certain cases, i.e. without being required to do so by treaties (one example is PRRS).

An important prerequisite for comparing disease-free status between individual regions and countries is that the quality of surveillance and the results obtained permit statistically sound conclusions and are therefore comparable. The scientific and statistical basis of the Swiss surveillance programmes meets this condition.

3.2 Random sample testing

3.2.1 Risk-based random sample calculation

Switzerland's bilateral agreements with the EU call for the tests necessary to demonstrate disease-free status to be repeated annually. The reason for this is that the tests can only detect a prior outbreak of disease. They therefore provide meaningful results only for the past year. Based on the following consideration, it is possible to reduce the extent of repeat sampling: once freedom from disease has been successfully demonstrated there remains a constant, small possibility of the disease being introduced despite import rules and tests. As a result, the level of confidence decreases over time. This decrease is calculated using a quantitative risk assessment. The annual repeating of the testing programme therefore only needs to compensate for this decrease in confidence. Using this calculation method developed by the FSVO, we are able to reduce the number of farms tested annually and to do so on a scientifically sound basis.

3.2.2 Risk-based farm selection

Farms that have an increased risk of the disease are described as "sentinel farms". They are specifically included in the sample. Because these farms have a higher risk of the disease, the total number of farms in the sample can be reduced.

To apply risk-based farm selection, risk factors are identified and quantified. These are used to gauge the probability of a disease occurring on a farm. This gives the relative risk of individual farms. This means that a farm with a high relative risk counts more heavily for surveillance purposes than another farm with a smaller calculated risk. For example, one farm with three times the relative risk can replace three farms with an average relative risk. This allows us to reduce the number of farms for testing.

Our programmes combine risk-based farm selection with random sampling and the majority of farms are still selected at random. This means that the sample can still be considered as random, while the risk-based component allows for a reduction in the sample size.

3.2.3 Confidence of freedom from disease

The testing of statistically collected samples allows us to draw conclusions about the total population by means of probability calculation (stochastics). In the case of demonstrating freedom from disease, we therefore determine how probable it is that an animal disease can be ruled out in a population if no positive cases were found. This probability is described as the confidence of freedom from disease. The requirement for the surveillance programme is that a certain assumed prevalence at herd level (the "design prevalence") has to be detected with a defined level of confidence. Specifically: at least one contaminated farm – out of several farms assumed to be contaminated – would need to be found in the

sample with a given probability. Based on this assumption, we calculate the necessary sample size. For IBR, EBL, brucellosis in small ruminants, Aujeszky's disease and Newcastle Disease, the requirements are set out in the bilateral agreements with the EU; for PRRS (voluntary demonstration of disease-free status), they are defined independently.

It is important to note that the aim of the surveillance programme is to demonstrate freedom from a particular animal disease. No positive cases should be identified outside the sample, e.g. by testing suspected cases or investigating abortions. The assumed disease prevalence serves solely to aid calculation and does not mean that any infected farms should exist outside the sample – otherwise Switzerland would lose disease-free status.

3.2.4 Evaluation of samples

Since 2012, the FSVO has been using a statistical method (Bayesian method) to evaluate the samples, combining the results of the current sample with sample information from previous years (see risk-based random sample calculation, Section 3.2.1). To calculate the decrease in confidence for the previous year's sample, a quantitative risk assessment was carried out over many years. The resulting information is included in the Bayesian method, but without carrying out a risk assessment every time: in evaluating the current sample, a fixed value for the annual decrease in confidence for the previous year's sample is considered, provided the number of imported animals is below a specified level.

3.3 Farm selection

Normally, the objective of a surveillance programme to demonstrate freedom from disease is a statement at farm level. If the sampling unit is the farm, we calculate, for each farm tested, how reliably we can rule out infection of the herd or flock. In doing so, we take the total tests of individual animals as a diagnostic test for the farm. Farms can be grouped into different farm categories.

Where requirements exist at animal level, the calculation is carried out – for simplicity – at animal level without considering the farm.

3.3.1 Risk factors and risk groups

In order to integrate farms into the sample on a risk basis in addition to random selection (see risk-based farm selection and/or sentinel farms), disease-specific risk factors need to be determined in advance. Farms with the same combination of risk factors have the same relative risk of the disease; they belong to the same risk group. Farms with a very high risk of the disease (upper risk groups) are selected as sentinel farms. Farms with a lower risk (lower risk groups) are selected at random.

3.3.2 Cattle

Farms from which milk samples are collected regularly for milk testing by Suisselab AG in Zollikofen are classed as dairy (milk supplying) farms; all other farms are classed as non-dairy.

3.3.3 Sheep and goats

The sheep and goat populations are regarded as a single population for brucellosis in small ruminants. A farm with sheep and goats is counted twice in the population and sample: once as a sheep farm and once as a goat farm.

3.3.4 Pigs

The target population of the surveillance programme comprises all pig farms, irrespective of whether fattening or breeding pigs are sampled. This is due to the special structure of pig farms in production (breeding pyramid). However, depending on whether breeding or fattening pigs are sampled, the population and sample may comprise only fattening, breeding or mixed farms.

3.4 Laboratory testing

3.4.1 Sample collection

Some of the blood samples are collected on farms by authorised veterinarians. The samples are sent for testing to several FSVO-approved laboratories, where they are individually diagnosed. The veterinarian must complete a sampling report for each selected farm. If no blood samples could be taken, for example because the farm had stopped keeping the species in question or had no animals at the time of inspection, the reason must be given.

The other blood samples are collected at the slaughterhouse. Traceability of the animals sampled is important in this respect. Most sampling of cattle, pigs and poultry is carried out at the slaughterhouse by the official veterinarians or employees responsible for meat inspection.

The milk samples tested come from milk inspection at Suisselab AG (Zollikofen). Besides being used for milk quality testing, these samples are also used for the diagnosis of animal diseases.

In the case of cattle, traceability is ensured via the animal movements database (AMD); in the case of pigs, the official veterinarians responsible for meat inspection record the animals' farm of origin. For cattle samples, official veterinarians are supported by a web service of the animal movements database on cattle sampling at the slaughterhouse ("RIBES"). This web service shows the veterinarian which animals to sample, in the slaughterhouse's commercial software (ERP) or via an app and creates the documentation (test request and sample labelling). Shifting the sampling for non-dairy cattle from farm to slaughterhouse has made sample collection easier and less dangerous. However, the design of the surveillance programmes has had to be adjusted, as only a few animals per farm can be tested; however, the results depend on how many animals from individual farms are sent for slaughter.

Since it is assumed prior to sample testing that Switzerland is free of the diseases in question, a negative test result is expected. Neither the competent veterinary authorities nor the keepers of the herds tested are sent a laboratory report if the results are negative.

3.4.2 Sensitivity and specificity

Any laboratory diagnostic method can yield false results, albeit very rarely and only under certain conditions. The result can be false-negative or false-positive. In the case of a false-negative result, an infected animal is not recognised as such. False-negative results reduce the sensitivity of a test. The sensitivity indicates the proportion of infected animals correctly detected as positive in the test. In the case of a false-positive result, a healthy animal is wrongly identified as infected. False-positive results reduce the specificity of a test. The specificity indicates the proportion of non-infected animals correctly detected as negative in the test.

To demonstrate freedom from disease, a serological test for specific antibodies is usually carried out. The first step is to carry out a screening test, usually an ELISA, that is as sensitive as possible. This ensures that no infected animals are missed. However, it may give a few false-positive results. Samples testing positive in the ELISA are then retested using a specific test to identify the false-positive samples. These confirmation tests on all positive samples are carried out by the national reference laboratory for the disease in question.

3.4.3 Evaluation of laboratory results

Here a distinction needs to be drawn between laboratory tests detecting antibodies and those detecting pathogens. In demonstrating freedom from disease, most samples are tested for the presence of antibodies. If antibodies are found, it means the animal was in contact with the pathogen at some time and its immune system responded by producing antibodies. However, it can also mean that the animal was vaccinated, in which case it cannot infect other animals. Very rarely, animals may react positively to a serological test even though they have never had contact with the pathogen in question. These animals are described as "singleton reactors". Reasons for this response include non-specific immune reactions or cross-reactions with other pathogens. False-positive PCR results may occur, for example, if there are

other closely related pathogens with genetic material very similar to that of the pathogen in question. As a result, different initial situations can lead to the same positive test result. In the event of a positive finding, therefore, the situation needs to be clarified more precisely. Investigations are based on the measures prescribed in the Epizootic Diseases Ordinance (EzDO) in the event of an animal disease. It is only by conducting further tests on the animal and by investigating the affected farm and in-contact farms that we can differentiate singleton reactors from a real disease outbreak, identify the introduction route and tailor measures to the actual risk. In an international level, it is important to demonstrate that these are singleton reactors – as this does not lead to the loss of disease-free status.

4 Demonstrating freedom from disease: disease-specific information

The programme for **demonstrating freedom from ND in poultry** is based on the programme for early detection of LPAI, and sampling is carried out jointly for both diseases. ND is therefore described together with LPAI in Section 6.1.

4.1 Infectious bovine rhinotracheitis (IBR) and enzootic bovine leukosis (EBL)

4.1.1 Requirements

The aim of the national surveillance programme is to demonstrate that the Swiss cattle population is free of IBR and EBL in accordance with the bilateral agreements with the EU and to detect any disease outbreaks early with the highest possible probability. According to Commission Delegated Regulation (EU) 2020/689, annual IBR and EBL surveillance must be carried out to allow at least for the detection of infection in farms with BHV-1 or EBL with a target prevalence of 0.2% and a confidence level of 95%. In parallel with active surveillance in accordance with the bilateral agreements with the EU, testing for infectious bovine rhinotracheitis/infectious pustular vulvovaginitis (IBR/IPV) is carried out on abortions, artificial insemination bulls and animals participating in shows or admitted to animal hospitals. For enzootic bovine leukosis (EBL), no further surveillance testing is conducted outside the sample. Lymph node changes detected during meat inspection are investigated. All of these tests must be negative in order to demonstrate freedom from disease for both of these diseases.

4.1.2 Sample calculation

The sampling procedure is identical for IBR and EBL, and largely the same farms and animals are tested. This keeps sampling and logistical costs low. Because testing using bulk-tank milk samples is much cheaper for a farm than testing using individual animal blood samples (although this is necessary for non-dairy farms), it seems attractive to focus on testing dairy farms. However, such an approach would violate the basic principle of random sample selection. Dairy (D) and non-dairy (ND) farms are therefore regarded as separate sub-populations and freedom from disease is demonstrated separately for each. Looking at the overall bovine population, these objectives go well beyond the EU requirements. There is therefore a greater probability of detecting any outbreaks of IBR or EBL.

The 2024 surveillance programme was designed in such a way that there is a 80% confidence of detecting the 0.2% design prevalence (corresponding to around 80 infected farms) in both sub-populations (dairy and non-dairy farms). Both requirements stem from the bilateral agreements with the EU and apply to the entire bovine population. Extrapolating from sub-populations to total population yields either a very high confidence at a 0.2% design prevalence or approximately halves the design prevalence at an existing confidence level of 96%.

Besides dividing farms into dairy and non-dairy, it is also necessary for risk-based farm selection to distinguish between sentinel farms and randomly selected farms in both sub-populations. Half of the necessary confidence comes from the testing of randomly selected farms. The other half comes from the testing of sentinel farms. Owing to the stochastic correlation, a confidence level of 80% corresponds to half of a 99% confidence level. At least 80% confidence must therefore come from each of the four types of farm (Table 2.2.1-1). The EBL random sample requires more sentinel farms than the IBR random sample. The reason for this is the smaller number of risk factors in the case of EBL. Because EBL sentinel farms are integrated into the IBR random sample, slightly fewer randomly selected farms were

tested for IBR than for EBL. However, since the number of farms involved is comparatively small and the organisational effort would be comparatively high, this discrepancy is not compensated for All farms and animals are simply tested for both diseases. A reserve is added to the calculated number of samples, since it may not be possible to sample individual selected farms. In the case of non-dairy farms, we do not use an additional reserve because freedom from disease must be demonstrated for the total population and over-testing would entail comparatively high costs. The risk-based sample calculation to reduce the number of farms to be tested is abandoned in favour of higher surveillance quality. This is justified because there is a real risk of introduction of both animal diseases.

4.1.3 Selection and testing of farms

For random sampling to test for IBR and EBL, some of the cattle selected for BVD are sampled. For the random sample, holdings are therefore not selected in advance; rather, the first 9,000 or so cattle arriving at the slaughterhouse and also being monitored under the BVD programme are selected. No random selection of cattle and holdings to be sampled is possible in advance, as it is not known which cattle are to be slaughtered. However, the draw corresponds to a random selection, since there is no known distortion due to this procedure. Sentinel farms, on the other hand, are identified *a priori*. Sampling at the slaughterhouse is carried out with the aid of the "RIBES" system, which triggers a signal at the slaughterhouse when a sample needs to be taken from a slaughtered bovine animal.

Table 4.1.3-1: Selection of farms and sample collection period

Epizootic disease	**IBR and EBL**			
Farm type	**Non-dairy farms** (blood samples)		**Dairy farms** (bulk-tank milk samples)	
Data basis	AND as at 11.11 in the previous year		Milk testing as at 11.11 in the previous year	
Selection method	Random selection	Sentinel farms	Random selection	Sentinel farms
Random selection	Yes	No	Yes	No
Stratification	Yes	No	Yes	No
Sampling period	1 January to around March	Until confidence level reached	2 samples per farm, in January and April	

The bulk-tank milk sample is a pooled sample from all lactating cows on a farm. When testing bulk-tank milk samples, we need to bear in mind that only some of the cows on a farm are in lactation at any one time. We therefore test two samples with a three-month interval to cover all cows on a farm, or calculate the herd sensitivity for a sampling, reducing the test sensitivity by a factor corresponding to the proportion of non-lactating cows.

For IBR and EBL, in addition to random selection, we apply risk-based selection of sentinel farms.

IBR sentinel farms have one or more of the following characteristics identified in a survey of experts as IBR risk factors:

- Summer pasturing
- Farms with above-average animal movement (animal movements in the AMD)
- Farms that have imported cattle
- Farms close to the border (within 5 km of the border and cross-border roads)
- Farms in areas with a high farm density (farms/km^2)

These five risk factors give 32 possible combinations or risk groups. Sentinel farms are selected from the upper risk groups.

In a separate survey of experts, three EBL risk factors were identified for the selection of sentinel farms:

- Summer pasturing
- Farms with above-average animal movement (AMD)
- Farms that have imported cattle

These three risk factors give eight possible combinations or risk groups. Farms with the highest relative risk are used as sentinel farms. Farms with a lower risk are not all required; sentinel farms from this group are therefore selected at random. The rest of the procedure is the same as for IBR. The risk factors used are determined each year in November on the basis of the data from the previous 12 months.

4.1.4 Selection and testing of animals

On non-dairy farms, blood samples are collected from bovine animals between six months and five years old and tested for IBR and EBL antibodies. When sampling at the slaughterhouse using RIBES, the number of animals per farm depends on the size of the group of animals to be tested for BVD. In most cases, the number of animals is five.

During on-farm sampling, if fewer than seven animals are older than 24 months, a total of seven blood samples are collected, including some from younger animals.

However, in the case of dairy farms, it is not known which cows supplied the milk contained in the bulk-tank milk sample. But by testing two samples with a three-month interval, there is a high likelihood that all lactating cows on the farm will be covered. Young stock and male animals are not covered by the testing of bulk-tank milk.

In the case of dairy farms, two samples with a three-month interval enable us to achieve an over 99% probability of detecting any bovine animal infected with IBR or EBL. With only one sample, however, the herd sensitivity would be only 78.8%.

4.1.5 Laboratory testing

In the case of bulk-tank milk samples, diagnosis is based on the remaining sample material after official milk testing has been carried out by Suisselab AG. All laboratory procedures serve to provide evidence of the presence of antibodies against BHV-1 or BLV. If the results are positive, the samples are subjected to confirmation tests according to Table 4.1.5-1 and 4.1.5-2.

Table 4.1.5-1: Methods used to test for IBR

Animal disease	**IBR**	
Type of sample	Blood samples	Bulk-tank milk samples
Screening method	ELISA test	ELISA test
Sensitivity and specificity for individual animal / farm	99.3% and 98.3% / depending on farm size and number of samples tested; sensitivity for randomly selected farms Ø 30%; sentinel farms Ø 68%; specificity 100%	Both almost 100%; with one sample, herd sensitivity 78.8%
Confirmation testing method for positive samples	Serum neutralisation test	Blood samples on farm; all bovine animals > 24 months
Sensitivity and specificity	98.3–100%	99% and 100%
Reference laboratory	Institute of Virology of the Vetsuisse Faculty of the University of Zurich	

Table 4.1.5-2: Methods used to test for EBL

Animal disease	**EBL**	
Type of sample	Blood samples	Bulk-tank milk samples
Screening method	ELISA test	ELISA test
Sensitivity and specificity	Almost 100% and 99.8% respectively	Both almost 100%; with one sample, herd sensitivity 78.8%

Confirmation testing method for positive samples	ELISA-Ab GP-51	ELISA-Ab GP-51 on blood samples
Sensitivity and specificity for individual animal / farm	Almost 100% or 99.5 / sensitivity for randomly selected farms Ø 30%; sentinel farms Ø 68%; specificity 99.5%	–
Reference laboratory	Institute of Virology and Immunology (IVI) of the Vetsuisse Faculty at the University of Bern	

4.1.6 Case definition

The Epizootic Diseases Ordinance stipulates that in the case of IBR and EBL each antibody-positive bovine animal confirmed by the reference laboratory constitutes a case of disease and that measures must be taken on the farm concerned.

The additional investigations required in the event of disease make it possible to differentiate between a singleton reactor and an actual disease outbreak. If the findings are confined to a serologically positive result for an individual animal and no virus is found, the case is classed as a singleton reactor.

4.2 Bluetongue disease

4.2.1 Requirements

The spread of BTV-8 in Switzerland was detected in 2017. Following the last confirmed case of BTV-8 on 13 November 2020, Switzerland has been providing evidence of BT-free status according to self-declaration at national and regional level.

4.2.2 Sample calculation

The random sample screening programme has to be divided into “BT areas”, defined as areas of 2,000 square kilometres. However, this definition can be waived in favour of existing administrative boundaries. We used geostatistical methods to structure these BT surveillance areas in such a way that they correspond to the cantons as far as possible. This created a total of 16 BT areas for Switzerland, as several small cantons were combined into a single BT area. We also made sure that not only the land area but also the populations of susceptible species are approximately the same in each BT area. This enables us to test the same number of animals in each BT area. The Principality of Liechtenstein is listed as a separate BT area. However, its land area and animal population are much smaller than those of the other BT areas and in epidemiological terms it should be considered together with the adjacent BT area “AI AR SG”.

At national level, a 0.2% prevalence at animal level has to be demonstrated with 99% confidence; in each of the 16 BT areas, a 2% prevalence at animal level has to be demonstrated with 95% confidence. As a first step, the sample size per BT area was calculated based on the average population size of a BT area. This number of samples per BT area was multiplied by 16 to obtain the required number of samples at national level. The validity of this size of population was then calculated at national level. If it is not sufficient for the required 99% confidence level, the required number of samples at national level is calculated directly as a second step and this number is then divided between the 16 BT areas. The sample size per BT area is 150 bovine animals. For the whole of Switzerland, therefore, 2,400 bovine animals had to be tested. Based on experience with previous surveillance programmes, 490 animals were estimated as a reserve. In the case of BT, the reserve ensures that the testing targets are achieved in all BT areas.

4.2.3 Selection and testing of animals

Only bovine animals are tested in the surveillance programme. The blood samples are collected at six large slaughterhouses with the aid of “RIBES”. Both the sampling and the selection of animals are carried out by the on-site meat inspectors. Animals must meet the following conditions:

- They must not be vaccinated. For that reason, samples are only taken from cattle born after May 2010.
- The cattle must be at least 8 months old. This allows the influence of maternal antibodies to be ruled out and ensures that the animals have been exposed to potential transmission for as long as possible. Serological testing of older animals and of bulk-tank milk samples has shown that animals vaccinated against BT are still serologically positive 4–5 years after vaccination and can therefore pass on antibodies to their calves. These animals would thus be protected against BTV-8 infection and would be negative in a PCR test.

If possible, only single animals should be sampled from each farm. This limits the number of samples per farm in RIBES. Samples for the 2023 programme were taken between November and December, corresponding to the end of the season with high midge activity. The PCR test is positive for up to 160 days in infected animals.

4.2.4 Laboratory testing

In random BT testing, blood samples from individual animals are tested (Table). The samples are sent to several FSVO-approved laboratories. Traceability back to the farm of origin is ensured by meat inspection information and animal histories in the animal movements database.

Diagnosis focuses on detection of the BTV genome. Additionally in the case of BT, a specific PCR is used to determine the serotype.

Table 4.2.4-1: Methods used to test for BTV

Epizootic disease	**BT**
Type of sample	Blood samples
Screening method **Sensitivity and specificity**	Pan-BTV-PCR on virus genome of all known BTV serotypes tested; pools of 5 99.99 % and 99.99 % respectively
Confirmation testing for positive samples **Sensitivity and specificity**	Serotype-specific PCR No information
Reference laboratory	Institute of Virology and Immunology (IVI), Mittelhäusern

4.2.5 Case definition

The Animal Diseases Ordinance stipulates that in the case of bluetongue any animal that tests positive constitutes an occurrence of the disease and that measures must be taken on the farm concerned.

4.3 Aujeszky's disease (AD) and porcine reproductive and respiratory syndrome (PRRS)

4.3.1 Requirements

Random sampling for Aujeszky's disease has been in place since 2001. Because Switzerland's neighbouring countries are also free of Aujeszky's disease and no or very few live breeding pigs are imported, there is only a low risk of introduction. However, antibody-positive animals have been found in Switzerland in the past during testing of wild boar. Based on the bilateral agreements with the EU, the sensible approach for Aujeszky's disease is to carry out a surveillance programme by means of random sampling. The programme is necessary in order to export live pigs and derived products to countries which also have disease-free status. This also allows us to regulate imports of live pigs and porcine semen.

European animal health legislation (Delegated Regulation 2020/689) allows surveillance of Aujeszky's disease taking into account factors such as the production systems, and this is applied in Switzerland due to the small-scale production structure.

In the case of PRRS, there is a high risk of introduction. The disease has spread rapidly in Europe since the mid-1990s and occurs in most European countries. It is therefore important to have a sound basis for the annual testing programmes. This basis was set in 2001 to show that Switzerland was free from PRRS. At that time, following a minor outbreak, a mass screening was carried out, in which over 40,000 pigs were serologically tested for PRRS. The outcome confirmed the fact that at that time, having successfully combated the outbreak, Switzerland was free of PRRS once again. Since then, random testing has been sufficient to demonstrate freedom from the disease. However, a risk of introduction remains, as shown by outbreaks in 2012 and 2014 as well as the case in 2020 following an illegal animal import. And in recent years antibody-positive animals have been found in Switzerland during testing of wild boar. Strong disease awareness and effective early detection are therefore extremely important. Animals showing typical clinical signs must be investigated. For example, breeding sows in a herd with a noticeably high rate of abortions must be tested for PRRS. All pigs tested for swine fever due to a suspicion or for exclusion purposes will continue to be tested for PRRS as well, as the clinical symptoms are the same.

According to European animal health legislation (Implementing Regulation (EU) 2018/1882), PRRS is a listed disease "for which measures are needed to prevent it from spreading on account of its entry into the Union or movements between Member States". However, there are no provisions with regard to surveillance. The PRRS surveillance programme is therefore based on that for Aujeszky's disease. The surveillance programme is carried out to confirm Switzerland's PRRS-free status and thus to demand an equivalent quality standard in international trade.

The PRRS surveillance programme is identical to that for Aujeszky's disease; the samples collected are tested for both diseases. Synergies between the two programmes are exploited to the full, leading to low sampling and logistical costs. This also ensures that the PRRS surveillance programme is underpinned by scientific and statistical data.

4.3.2 Sample calculation

For the programme we apply risk-based sample calculation (see 3.2.1). The reason is that the risk of introducing Aujeszky's disease is very low and there have been no further outbreaks in Switzerland since the introduction of random testing. This means that only the decrease in confidence for the previous year needs to be compensated for, so that the annual sample is smaller. The lower surveillance quality of random sampling associated with this procedure is not a concern for Aujeszky's disease and we are able to exploit the economic advantages. As the outbreaks in recent years show, there is a real risk of introduction in the case of PRRS, in contrast to Aujeszky's disease. However, there are no internationally valid additional guarantees that would require a surveillance programme for PRRS. The efficient combination of both samples is therefore weighted more heavily than improved early detection, primarily relevant to PRRS, through a larger sample without risk-based sample calculation. In order to take this aspect into account, breeding pigs (which are logistically easier to sample) are also tested in addition to fattening pigs. Breeding farms are important for the spread of the virus and have a higher risk of virus introduction than fattening farms. By including breeding farms, outbreaks can therefore be detected earlier and traced more effectively than if only the fattening farms downstream in the production chain were investigated.

For both Aujeszky's disease and PRRS, we need to be able to demonstrate in a random sample with 99% confidence that herd prevalence is below 0.2%. Because Switzerland largely stopped imported breeding pigs several years ago, it is not possible to carry out a quantitative import risk assessment. The method therefore uses the simplified procedure, in which an annual 10% decrease in confidence is integrated into the calculation. This 10% figure is based on a management decision and is intended to encompass all conceivable import risks. With this 10% decrease in confidence, the residual confidence from the previous year's sample is approximately 90%, which corresponds to a halving of the confidence level. The confidence level from the current sample must therefore also be 90% to compensate for the previous year's decrease and achieve an overall confidence level of 99%.

The sample size is determined on the basis of the average number of samples per holding of origin and the test sensitivity for PRRS (94%), which is lower than in the case of Aujeszky's disease. If an average

of six animals are tested per farm, as has been done in recent years, a sensitivity of 87% is achieved, assuming a prevalence of 30% of diseased animals on an infected farm. In order to achieve an overall sensitivity, i.e. confidence level for the current sample, of 90%, it was necessary to test 1,203 farms, i.e. 7,218 samples, for a total population of 6,000 holdings (rounded up) and a design prevalence of 0.2%. However, since it is not logistically possible for slaughterhouses to sample an exact number of breeding sows per farm of origin, the number of animals actually included in the sample varies per breeding farm. This variation in number of samples per farm reduces the overall reliability of the sample. To compensate for this, a reserve of around 500 samples was added. This gives a planned sample size of 7,700 samples in total. The division between breeding and fattening farms is based on their proportions in the Swiss pig population: 5,000 samples from fattening pigs and 2,700 samples from breeding pigs.

4.3.3 Selection and testing of farms

In order to carry out screenings for Aujeszky's disease and PRRS, farms are selected by means of convenience sampling by the meat control personnel at 11 slaughterhouses. The meat inspectors decide independently from which animals and thus from which farms they will take samples. The FSVO specifies the sampling period and the total number of samples to be taken by the slaughterhouse, as well as the number of farms of origin to be tested in the case of fattening pigs. There is no such requirement for breeding sows, as this would not be logistically feasible for slaughterhouses.

4.3.4 Selection and testing of animals

Animals are not selected in advance. The animals to be sampled are selected at random by the meat inspectors at the slaughterhouse. For fattening pigs, five animals per farm of origin should be tested. There are no requirements for breeding pigs, as this would not be logistically feasible for slaughterhouses.

Table 4.3.4-1: Total number of pig farms in Switzerland and the calculated sample size at sample level.

Epizootic disease	**Aujeszky's disease and PRRS**
Animal category	Breeding pigs and fattening pigs
Total samples	7700 blood samples from individual animals (2700 breeding pigs, 5000 fattening pigs from 1000 farms)
Total number of pig farms	Around 5800, including 1800 breeding farms
Samples per farm	Fattening pigs 5 samples per farm, breeding pigs no requirements
Sampling period	1 January to 31 July

4.3.5 Laboratory testing

The blood samples taken by meat inspectors are sent to the designated diagnostic laboratories, where they are tested for antibodies against Aujeszky's disease and PRRS. The screening and confirmation testing methods, respective sensitivities and specificities, and reference laboratory for Aujeszky's disease are indicated below (Table 4.3.5-1 and 4.2.5-2).

Table 4.3.5-1: Methods used to test for Aujeszky's disease, including sensitivity and specificity, and the reference laboratory for Aujeszky's disease

Epizootic disease	**Aujeszky's disease**
Type of sample	Blood samples
Screening method **Sensitivity and specificity**	ELISA test 99.5% and 99.9% respectively
Confirmation testing method for positive samples **Sensitivity and specificity**	Serum neutralisation test (SNT) Gold standard, over 99.5%

Reference laboratory	Institute of Virology of the VETSUISSE Faculty of the University of Zurich

Table 4.3.5-2: Methods used to test for PRRS, including sensitivity and specificity, and the PRRS reference laboratory

Epizootic disease	**PRRS**
Type of sample	Blood samples
Screening method **Sensitivity and specificity**	ELISA test 94% and 99.1% respectively
Confirmation testing method for positive samples **Sensitivity and specificity**	Indirect fluorescence antibody (IFA) test 96% and 98.7% respectively
Reference laboratory	Institute of Virology and Immunology (IVI), Mittelhäusern

4.3.6 Case definition

The Epizootic Diseases Ordinance stipulates that in the case of Aujeszky's disease each antibody-positive pig confirmed by the reference laboratory constitutes a case of disease and that measures must be taken on the farm concerned.

For PRRS, the Epizootic Diseases Ordinance stipulates that two antibody-positive pigs on a farm, confirmed by the reference laboratory, constitute a case of disease. This special definition is necessary due to the comparatively low specificity of PRRS diagnostics. If the virus is detected, on the other hand, even a single pig constitutes a case of disease. For example, if only one pig is confirmed as seropositive out of the six pigs sampled per farm, further samples must be taken on the farm of origin and submitted for testing. These results will determine whether or not a case of disease is recorded.

However, in the case of both diseases, different initial situations can lead to a positive test result. It is therefore important to investigate the situation more closely and to differentiate between singleton reactors and a real disease outbreak.

4.4 Brucellosis in small ruminants

4.4.1 Requirements

Freedom from disease in the sheep and goat populations is documented annually by an active surveillance programme. The aim of the national surveillance programme is to demonstrate that the Swiss sheep and goat population is free of *B. abortus/melitensis/suis* in accordance with the bilateral Agreement on Agriculture between Switzerland and the EU with a confidence of at least 95% at a herd prevalence of over 0.2%.

4.4.2 Sample calculation

In the case of brucellosis, a risk-based random sample calculation is used (Hadorn 2002)[1]. The reason is that the risk of introducing brucellosis into Switzerland is very low and there have been no outbreaks since the start of sampling. The lower surveillance quality of random sampling associated with this procedure is therefore not a concern and we are able to exploit the economic advantages. We use the Bayesian method to evaluate the sample. In evaluating the current random sample, we assume a decline in confidence for previous samples based on import numbers and the origin of these imports. Provided that no more than 800 small ruminants were imported during the previous year, we calculate with a

[1] Hadorn DC, Rüfenacht J, Hauser R, Stärk KD. Risk-based design of repeated surveys for the documentation of freedom from non-highly contagious diseases. Prev Vet Med. 2002 Dec 30;56(3):179-92. doi: 10.1016/s0167-5877(02)00193-9. PMID: 12441234.

probability of 96.5% (table) that no brucellosis has been introduced. This probability was calculated in a risk assessment model of the VPHI (2010, scenario B). Scenario B is a conservative scenario which assumes that 50% of the imports originate from countries that are not free of brucellosis and has the aim of not overestimating the resulting confidence level of the current samples.

4.4.3 Selection and testing of farms

The farms to be sampled are selected at random from the Agricultural Policy Information System (AGIS). Goat farms must register at least three goats in AGIS and must be included as a sheep or goat farm in the Animal Transport Database (TVD).

4.4.4 Selection and testing of animals

Sheep and goats over 12 months old are tested. In larger herds, a random sample of animals is used. Animals are selected at random. The herd sensitivity is the probability of detecting an existing infection in a herd by means of random sampling. It depends on the sensitivity of the individual animal diagnostics used (assumption = 99%), the proportion of infected animals in the herd (intra-herd prevalence; assumption = 15%) and the number of animals tested. The larger the sample, the greater the probability of detecting an infected farm. As of 2022, the programme for sampling in sheep and goat farms was adjusted (Table 4.4.4-1), enabling us to reduce the number of samples in small and medium-size farms (the majority of Swiss farms) in comparison to before while respecting the safety standards.

Table 4.4.4-1 Sampling schedule by herd size

Herd size (number of animals over 12 months old)	< 19	20–29	30–55	≥ 56
Number of blood samples	all	19	23	29

4.4.5 Laboratory testing

The laboratory tests the samples for Brucella antibodies using the ELISA method. Any laboratory diagnostic method can produce false-negative or false-positive results, albeit very rarely and only under certain conditions. The sensitivity and specificity of the laboratory test have not been scientifically published. Nevertheless, investigations by the reference laboratory and all experience to date show that the tests are very good and suitable for use in demonstrating freedom from disease. Follow-up tests after a non-negative ELISA result can be found in the appendix to the technical directive on sampling and testing for brucellosis. Based on this, a distinction is drawn between individual cases (singleton reactors) and epidemics. Singleton reactors are different from an actual disease outbreak and do not jeopardize disease-free status. Singleton reactors are rare in the case of brucellosis.

4.4.6 Case definition

A clinical and/or pathological-anatomical suspicion that is confirmed by detection in culture. If laboratory diagnosis in serum samples indicates a suspected case, the procedure set out in the appendix to the technical directive on sampling and testing for brucellosis is applicable.

5 Monitoring control: disease-specific information

5.1 Bovine viral diarrhoea (BVD)

5.1.1 Requirements

Freedom from disease is not demonstrated for BVD. As a result, there are no specific requirements for implementation of the surveillance programme. Nor is any random testing based on statistical principles carried out. No international requirements apply.

The 2024 BVD surveillance programme was based on the same concept as the 2023 BVD surveillance. All farms are to be inspected at least once a year. In addition, changes were made to the procedure for affected farms after the end of the farm and livestock quarantine.

5.1.2 Selection and testing of farms

All farms with cattle according to the animal movements database (AMD) are part of the active national surveillance programme. Cattle farms in the surveillance programme are divided into dairy and non-dairy farms according to the type of surveillance. Dairy farms are farms from which two bulk-tank milk samples were tested during the surveillance period. Non-dairy farms are tested once by means of blood samples from suitable cattle (cattle group). In most cases, the average of five samples was collected with the RIBES application in the large slaughterhouses or via the RIBES app in small slaughterhouses. Farms not suitable for RIBES have to be sampled by farm sampling. The cantons can also test “special farms” on an individual schedule (in particular, additional calf sampling by means of ear punching).

5.1.3 Selection and testing of animals

Serological testing of a group of bovine animals is subject to the following conditions: testing must cover 10% of the average number of animals kept in the herd, with a minimum of five animals, that are least six months old and no more than five years old, or over five years old with at least one negative serology result in the last five years. Animals have never tested serologically positive for BVD, have been kept exclusively in recognised BVD-free herds and have been in the current herd for a total of at least two months (on-farm samples six months) in the last 12 months. This information is also stored in and can be retrieved from the veterinary service information system (ISVet). These criteria are also used to select animals for sampling at the slaughterhouse. If the minimum number of five animals cannot be achieved, but 10% of the average bovine herd has been tested, the canton may class the farm as successfully monitored.

5.1.4 Laboratory testing

BVD diagnosis uses serological tests for samples of milk, bulk-tank milk and blood. Virological detection is performed by PCR or antigen ELISA. The reference laboratory also uses a range of additional tests, depending on the request.

5.1.5 Case definition

Detection of a persistently infected animal (PI animal) on a farm constitutes a case of disease. If additional PI animals are found on the farm, they are assigned to the previously identified case. If no PI animals are found but all test results indicate that one was present on a farm (it may have already been slaughtered, for example), the farm is classed as suspected of contamination.

5.2 *Salmonella* infection in poultry

5.2.1 Requirements

Salmonella infection in poultry is an animal disease to be controlled (EzDO Art. 255 et seq.). The aim of control is to prevent eggs or poultry meat from infected flocks from entering the human food chain. Control targets of <= 1% prevalence in breeders and broilers and <= 2% prevalence in layers have been set for this purpose. These targets relate to the serovars which most commonly pose a threat to human health. These are *S. enteritidis*, *S. typhimurium* and the monophasic *S. typhimurium* 1,4,[5],12:i:- variant and additionally *S. virchow, S. hadar* and *S. infantis* in breeding flocks. If these serovars are identified in the course of monitoring samples obtained from the animals, control measures are initiated.

5.2.2 Selection and testing of farms

Poultry farms with more than 250 breeders or 1,000 layers (or with 250–999 layers if the farm totalled at least 1,000 layers within a year across all flocks) or broiler chickens (if the floor area of the poultry house is more than 333 m^2) or broiler turkeys (if the floor area of the poultry house is more than 200 m^2) must test their poultry for Salmonella in accordance with the Technical directive on the collection and testing

of samples for Salmonella infection in domestic poultry. Most samples are taken by poultry farmers themselves, but official sampling is also necessary.

5.2.3 Selection and testing of animals

As a general rule, all flocks on the farms described above must be sampled regularly in accordance with the Technical directive on the collection and testing of samples for Salmonella infection in domestic poultry. Surveillance is generally carried out by testing boot covers or dust samples or by serology in eggs or blood. If Salmonella of the serovars concerned or Salmonella antibodies are detected in environmental samples or during serological testing, or if illness occurs in the human population due to consumption of poultry meat or eggs, a suspected case is recorded. In a suspected case, the official veterinarian takes samples from 20 birds.

5.2.4 Laboratory testing

Environmental samples are tested bacteriologically for Salmonella. Eggs and blood samples are tested serologically for Salmonella antibodies. Muscle, liver and spleen from the 20 animals sampled in the suspected case are tested bacteriologically for Salmonella.

5.2.5 Case definition

A case of disease is recorded if *S. enteritidis* or *S. typhimurium* or the monophasic *S. typhimurium* 1,4,[5],12:i:- variant are detected in the organs or breast muscle of poultry (additionally S. *virchow*, S. *hadar* and S. *infantis* in breeding birds).

6 Early detection of animal diseases: disease-specific information

6.1 Low pathogenic avian influenza (LPAI) and Newcastle disease (ND) in commercial poultry

6.1.1 Requirements

Since 2006, blood samples from Swiss commercial poultry have been tested for antibodies to avian influenza viruses (AIV) H5 / H7 and Newcastle Disease (ND). Until 2021, surveillance was primarily targeted at early detection of AIV and was limited to free-range laying hens and broiler turkeys. Broiler chickens were not sampled because there is only a low probability of AIV infection due to their short lifespan. Ducks and geese are often kept outdoors and are therefore more likely to come into contact with AIV. However, the risk of spreading low pathogenic avian influenza (LPAI) is regarded as low because these largely small flocks kept by hobbyists or pure-breed enthusiasts (<50 ducks/geese) rarely have close contact with commercial poultry farms. In addition, sampling these duck/goose flocks entails a great deal of effort.

With the entry into force of the new European animal health legislation (Regulation (EU) 2016/429 and Delegated Regulation (EU) 2020/689), the monitoring of poultry had to be adapted in order also to demonstrate freedom from ND without vaccination. For that reason, the previous monitoring was extended as of 2022 to include a risk-based component, such that freedom from ND can now also be demonstrated with a given confidence.

6.1.2 Sample calculation

From 2006 to 2021, the number of flocks to be tested was set in such a way that at least one LPAIV-infected farm was found at a herd prevalence of at least 5% with a confidence of 95%. For Switzerland, with around 250 laying hen farms, this meant a randomly and representatively drawn sample of 60 farms. In the case of broiler turkeys, all farms are sampled every year. The number of birds to be tested per flock was set in such a way that at least one LPAIV-seropositive bird is detected at a prevalence of ≥ 30% LPAIV-seropositive birds with a test sensitivity of 95%. Therefore at least ten birds per flock were sampled. Samples from the LPAI testing programme were also tested in the laboratory for Newcastle Disease (ND) antibodies. The samples were not taken for the purpose of demonstrating freedom from disease and were therefore not suitable for that purpose.

Since 2022, the number of flocks to be tested has been set in such a way that at least one ND-infected farm is found at a herd prevalence (design prevalence) of at least 1% and an intra-herd prevalence of at least 10% with a confidence of 95%. A test sensitivity of 98.9% for ND and 98.2% for AIV is assumed.

The degree of sampling consequently includes the following two components since 2022:

a) random sampling at the slaughterhouse: The sample size per year is between 60 and 80 free-range laying hen flocks and approximately 27 fattening turkey flocks. A maximum of one flock per farm should be tested per year. Ten blood samples are taken from each flock.

b) risk-based selection of sentinel farms: At least 40 and max. 50 sentinel farms, selected according to specific risk factors, should be examined per year. On these sentinel farms, one flock of 25 animals must be sampled per year (blood samples from chickens).

6.1.3 Selection and testing of farms

a) random sampling at the slaughterhouse:

Slaughterhouse sampling of free-range laying hen farms and fattening turkeys takes place in two large poultry slaughterhouses in Switzerland. Farms are selected at random by slaughterhouse staff and sampled no more than once a year.

b) risk-based selection of sentinel farms:

The FSVO selects the farms to be sampled and sends the list of farms to the cantonal veterinary offices. Samples are collected by employees of the cantonal veterinary offices on the farm of origin or at the slaughterhouse. Sentinel farms are determined based on the following risk factors using the scenario tree model according to Martin et al. (2007) (those highlighted in bold have the greatest influence in the model):

- **Keeping** (BTS / outdoors / organic):
  Outdoors and organic have a higher risk than BTS
- **Ducks, quails and/or geese on the farm** (yes, no):
  The presence of such species is a higher risk
- **Distance to still water** (<1km, >1 km):
  Distance below 1 km is a higher risk
- Poultry density (number of other farms with >50 animals within 1km: 0, 1-2, >2):
  The more farms located within one kilometre, the higher the risk
- Number of poultry species on the farm (1, 2-3, >3):
  Farms with more poultry species have a higher risk
- Presence of poultry farms with ducks, quails and/or geese within 1 km (yes, no):
  The presence of such farms within 1km means a higher risk
- Usage (fattening /laying / breeding):
  Due to age, laying/breeding animals have a higher risk than fattening animals

6.1.4 Selection and testing of animals

Animals are not selected in advance. The animals to be sampled are selected at random by employees at the slaughterhouse or the cantonal veterinary offices. For the random sample, blood samples must be taken from 10 laying hens or turkeys in a flock, and for the sentinel component, from 25 hens in a flock.

6.1.5 Laboratory testing

Blood samples from Swiss commercial poultry are tested for antibodies to avian influenza viruses (AIV) H5/H7 and Newcastle Disease (ND). Laboratory tests are carried out at the department for poultry and rabbit diseases (NRGK) of Vetsuisse Zürich. The diagnostic procedures comply with the requirements of the World Organisation for Animal Health (WOAH). All blood samples are tested using commercial ELISA tests (competitive (AI) / blocking (ND)). Positive and inconclusive samples are tested using a

haemagglutination inhibition test (HIT) to detect specific antibodies against the AIV subtypes H5/H7 or against avian orthoavulavirus 1 (AOAV-1).

6.1.6 Case definition

In infected flocks, we would expect to find antibodies in several birds. Flocks with only one bird showing an inconclusive test result are classed as negative and are not monitored further. Only if multiple birds in a flock give positive or inconclusive results is a farm classed as antibody-positive. Subsequent flocks or, in the case of farms with multiple age groups, the flocks remaining on the farm are tested serologically and virologically and epidemiological investigations are carried out.

6.2 Highly pathogenic avian influenza (HPAI) in wild birds

6.2.1 Requirements

Highly pathogenic avian influenza (HPAI, also known as bird flu) usually leads to significant clinical abnormalities and, depending on the virus subtype, wild bird species and weather conditions, may be fatal. HPAI viruses circulating in the wild bird population pose a risk of transmission to commercial poultry. To detect such circulation as early as possible, we test dead or diseased wild birds.

6.2.2 Selection and testing of animals

The public is asked to maintain increased vigilance. Findings of dead wild birds should be reported to the gamekeeper or police. Reported carcasses are collected and disposed of safely. Sampling should be carried out in the following cases:

A ***wild bird finding to be clarified*** is recorded if a swan, two or more waterfowl or birds of prey, or five or more other wild birds, are found diseased or dead at a single location within 24 hours, and there is no sufficiently substantiated connection to another cause of disease or death. Tests must always be requested using the NRGK's "Application for the testing of wild birds for classical avian influenza". It is especially important to give coordinates, the bird species and the number of dead birds found, as this provides an overall picture of the numbers of wild bird deaths.

6.2.3 Laboratory testing

The combined choanal and cloacal swabs are tested for influenza A viruses using RT-qPCR at the department for poultry and rabbit diseases (NRGK) of Vetsuisse Zürich.

6.2.4 Case definition

Detection of highly pathogenic influenza viruses is classed as a case of disease.

7 General information on animal disease surveillance

The principles of animal health surveillance are described online (in German) at: https://www.blv.admin.ch/blv/de/home/tiere/tiergesundheit/ueberwachung.html

The case numbers cited in this report are based on the FSVO's information system for disease reports (InfoSM). These can be found at: https://infosm.blv.admin.ch.

This report and those from previous years can be found under the heading "Surveillance of animal diseases" at: https://www.blv.admin.ch/blv/en/home/tiere/publikationen/statistiken-berichte-tiere.html.

The monthly FSVO Radar Bulletins on the international animal disease situation can be found (in German) at: https://www.blv.admin.ch/blv/de/home/tiere/tiergesundheit/frueherkennung/radar.html.