Approved: 12 December 2024

DOI: 10.2903/j.efsa.2025.9197

SCIENTIFIC REPORT

efsa JOURNAL

Avian influenza annual report 2023

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The declarations of interest of all scientific experts active in EFSA's work are available at https://open.efsa.europa.eu/experts

Abstract

All European Union (EU) Member States (MSs), along with Iceland, Norway, Switzerland and the United Kingdom (Northern Ireland), conduct surveillance for avian influenza (AI) in poultry and wild birds. EFSA, upon mandate of the European Commission, compiles and analyses this data in an annual report. This summary highlights findings from the 2023 surveillance activities. In 2023, 31 reporting countries (RCs) visited 21,183 **poultry** establishments (PEs). Of these, 18,557 underwent serological investigations, 2460 underwent virological investigations and 166 underwent both. Among the 18,723 PEs sampled for serological testing, 29 PEs (0.15%) were seropositive for influenza A(H5/H7) viruses, more in detail: 27 PEs tested positive for A(H5), 1 tested positive for A(H7) and 1 tested positive for both strains. These were found in eight RCs (Bulgaria, Poland, Germany, Spain, Sweden, Norway, Iceland and Finland). Of the 2626 PEs sampled for virological testing, 180 PEs (6.85%) were positive for influenza A(H5/H7) viruses. More precisely, 178 tested positive for A(H5), of which 161 positive for HPAI (H5N1) and 2 tested positive for A(H7). Positive PEs were reported by 12 RCs covering 14 different poultry categories. A total of 51,411 **wild birds** were sampled, with 6717 (13.07%) testing positive for HPAIVs by PCR from 25 RCs. Subtype A(H5N1) was the main influenza A virus identified (6531; 97%), similar to 2022. Twenty RCs reported 1940 wild birds testing positive for LPAI or AIV of unknown pathogenicity. For these, 1372 (67.5%) were nor A(H5) or A(H7), while 568 (29.3%) tested positive for A(H5). These findings reflect the ongoing efforts in early detection and monitoring of avian influenza to mitigate the risk of outbreaks in poultry populations throughout Europe.

KEYWORDS

2023, Avian Influenza virus, highly pathogenic, HPAI, low pathogenic, LPAI, poultry population, serology, virology, wild birds

CONTENTS

SUMMARY

The EU Member States, Iceland, Norway, Switzerland and the United Kingdom (Northern Ireland)[1] – referred in this document as Reporting Countries – run surveillance programmes to detect avian influenza viruses in poultry and wild birds, especially migratory ones, which often introduce AIVs into poultry establishments. This report summarises the results of the EU co-funded surveillance activities conducted in 2023, which included:

- **Virological surveys** monitor highly pathogenic avian influenza viruses (HPAIVs) of subtypes A(H5) and A(H7) in certain poultry (e.g. ducks and geese), which often show no significant symptoms. These may include serological surveys if needed, as part of risk-based surveillance.
- **Serological surveys** track low pathogenic avian influenza virus (LPAIVs) of subtypes A(H5) and A(H7) in high-risk poultry populations. Virological surveys can replace these when necessary. This also falls under risk-based surveillance.
- **Early detection** of avian influenza viruses (AIVs) in wild birds is achieved through virological surveys, focusing on birds found dead, injured, sick or hunted with clinical symptoms.

In addition, in line with Commission Delegated Regulation (EU) 2020/689, some MSs have reported sampling carried out as part of passive surveillance in poultry, targeting flocks were increased morbidity or mortality or abnormal production has been noted. Also, data on wild birds sampled, either caught and released (healthy) or hunted and tested as part of national active surveillance programmes were also reported by some MSs.

Risk-based sampling strategies for AI surveillance differ across countries, making the percentage of positives among various groups, such as poultry categories, potentially non-comparable between regions. Risk-based surveillance for AIV in these regions aims at early detection, and test outcomes cannot be used to estimate disease prevalence or incidence without considering the underlying risk-based scheme. Although there may be variations between species, countries and years, these differences do not reflect on the quality of the surveillance activities conducted.

With the 2023 report, RCs could submit, for the first time, data on the poultry population. EFSA will use this information to improve the interpretation of the submitted surveillance data.

- Poultry

In 2023, 21,183 PEs were sampled, less than the 22,171 PEs sampled in the previous year. Among these sampled PEs, 18,557 were tested using serological assays only; 2460 were tested using virological assays only; while 166 underwent both serological and virological investigations.

The number of PEs sampled in **serological surveys** varied across RCs. Denmark, Estonia, Hungary, Lithuania and the United Kingdom (Northern Ireland) did not report serological survey data. The most targeted poultry categories, i.e. sampled by at least 15 countries each, were conventional laying hens, fattening turkeys, breeding chickens and game birds (gallinaceous). Growers were targeted by only three RCs. None of the poultry categories were sampled by all RCs.

In 2023, 29 PEs tested seropositive for influenza A(H5/H7) viruses (i.e. 27 A(H5), 1 A(H7) and 1 A(H5 and H7)) in eight countries Bulgaria, Finland, Germany, Norway, Poland, Spain, Sweden and Iceland. The bird testing positive in Iceland was non-autochthonous (kept in quarantine in quarantine premises at the moment of the sampling).

Italy, the Netherlands and Romania accounted for over 60% of all reports of sampled PEs. However, as was the case in 2022 and 2021, no positive PE was found. The A(H5/H7) seropositivity rate in 2023 was 0.15%.

Waterfowl game birds and breeding geese had the highest proportions of A(H5/H7)-seropositive PEs at 7.8% and 4.4%, respectively, similar to 2022 findings. Poultry categories, like fattening ducks, geese, turkeys, conventional laying hens and the 'other' category, had seropositive rates below 1%. No positives were found in the eight other poultry categories. Despite large test numbers, only one A(H5)-seropositive PE was found in conventional laying hens and growers.

The number of PEs sampled for the **virological survey** varied among RCs. Austria, Belgium, Cyprus, Ireland, Malta, Romania and Switzerland did not perform any virological tests in 2023. Chickens and ducks were the primary focus (10 RCs). Other poultry tested included fattening ducks, laying hens and turkeys. Of 180 PEs tested, 6.85% were positive for influenza A(H5/H7) viruses. More precisely, 178 tested positive for A(H5), of which 161 positive for HPAI (H5N1) and 2 tested positive for A(H7). Twelve countries reported positive PEs: Bulgaria, Poland, Italy, Denmark, Spain, Germany, Estonia, Luxembourg, Norway, Lithuania, Slovakia and the Netherlands. Hungary, Bulgaria, Poland and Italy accounted for 66.2% of all samples and 56.5% of positive cases in 2023.

A(H5/H7)-positive PEs were reported from establishments from 14 different poultry categories out of the 16 categories defined. Breeding turkeys, ducks, geese and chickens, free-range and conventional laying hens, fattening turkeys and *others* were the poultry categories with a rate of A(H5/H7)-positive PEs survey by virology above the median at 5.2%. The poultry categories 'other' and 'fattening ducks' accounted for the largest numbers tested (61.8%); 72 and 19 PEs were identified, respectively, from each poultry category, which accounts for 50.5% of the positive PEs.

A(H5/H7)-positive PEs were reported from 14 out of 16 poultry categories. Categories with rates above the 5.2% median included breeding turkeys, ducks, geese, chickens, free-range and conventional laying hens, fattening turkeys and 'Other'.

[1] In accordance with the Agreement on the withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community, and in particular Article 5(4) of the Windsor Framework in conjunction with Annex 2 to that Framework, for the purposes of this scientific report, references to Member States include the United Kingdom in respect of Northern Ireland.

Categories 'Other' and fattening ducks made up 61.8% of tests, with 72 and 19 PEs identified respectively, making up 50.5% of positive PEs.

Finally, it is useful to note that data on the distribution and composition of the underlying poultry population have started to be collected and processed by EFSA. Once done, it should provide a better understanding of the underlying population for the different poultry categories as well as the RCs' sampling schemes, which should improve the interpretation of the AI surveillance results at the European level.

- Wild birds

Thirty-one reporting countries, including 27 member states, Iceland, Norway, Switzerland and the United Kingdom (Northern Ireland), provided results from surveillance of avian influenza viruses (AIVs) in wild birds in 2023. The surveillance was based on sampling and testing indicator birds, specifically those found dead, injured or exhibiting clinical signs. Therefore, the survey data pertains to disease detection and cannot be used to estimate prevalence within source populations. While variations may exist between species, countries and years, these differences do not reflect the quality of the surveillance activities performed. Consistent with previous reports, wild birds that were 'found dead' or 'alive with clinical signs' (including injured wild birds) were classified under passive surveillance, whereas birds reported as 'hunted with clinical signs', 'hunted without clinical signs' and 'alive without clinical signs' were considered as sampled through active surveillance activities.

In 2023, results were reported for 51,411 wild birds, with 34,143 from passive surveillance. This was an increase from 32,143 in 2022, mainly due to more surveillance in Italy (12,286). The proportion of birds sampled by passive surveillance remained consistent with 2022, although monthly sample sizes varied within regions.

Of the wild birds sampled, 89% were fully identified at the species level ($n = 30,413$), representing 319 species across 26 orders. The majority of the sampled wild birds belonged to the order Charadriiformes ($n = 10,209$). Significant numbers were also recorded for the orders Anseriformes, Passeriformes, Columbiformes and Accipitriformes (each with $n > 2000$). In 2023, 47 out of 50 species listed as targets in EU for HPAI surveillance were sampled. The proportion of wild birds belonging to these target species was 45.8% in passive surveillance samples and 66.1% in active surveillance samples.

A total of 8657 (16.8%) wild birds tested positive for AIVs: 6717 for HPAIVs and 1940 for LPAIVs (including non-A(H5/H7) subtypes). Most HPAIV-positive wild birds (6531 out of 6717) were identified as HPAI A(H5N1). The three species with the largest proportions of HPAIV-positive wild birds were *Larus ridibundus* (black-headed gull), *Sterna hirundo* (common tern) and *Cygnus olor* (mute swan). HPAIV-positive wild birds were identified across 87 different species. HPAIV-positive wild birds were also reported in 2023 by 25 countries, similar to the results from 2022, with only six RCs not reporting HPAIV detection: Bulgaria (89 samples), Cyprus (154 samples), Greece (42 samples), Luxembourg (54 samples), Malta (59 samples) and Slovakia (52 samples).

In 2023 HPAIV-positive wild birds were detected in waves with low HPAIV detection rates (under 7%) in the summer (between weeks 30 and 44).

A total of 1940 LPAIV-positive wild birds or AIV of unknown pathogenicity (grouped under the term LPAIV-positive in this report) were reported by 20 RCs. The LPAIV-positivity rates in wild birds remained low (below 7.5%) but were observed throughout the year. In 2023, the majority of LPAIV-positive wild birds were from the order Charadriiformes until autumn, after which most LPAIV-positive wild birds were from the Anseriformes order.

This report includes summary data on wild bird observations from the EuroBirdPortal (EBP), contributed by RCs. Despite data limitations, these data highlight where the HPAI target species may congregate, aiding RCs in targeted surveillance. Areas with a low density of observations may correspond to areas where the sensitivity of passive surveillance is low due to a lower 'effort', or to habitats which are not favourable to birds (low density of birds), or both. A previous study in Sweden warned that voluntary contributor-based data should be used with care, given the limitations of this data collection method (Snäll et al., 2011). Despite the limitations of the voluntary observation data presented in this report, and until further spatial modelling of the distribution of wild birds in Europe by species is readily available, the maps presented in this report (and also those linked to this report and shown in Zenodo[2]) may help to shed light on areas where the wild birds of the species belonging to the target list may gather, supporting RCs in carrying out more targeted surveillance activities.

[2]https://zenodo.org/uploads/14515393.

1 | INTRODUCTION

1.1 | The pathogen

Avian influenza is a contagious viral disease caused by a virus from the Orthomyxoviridae family, primarily affecting poultry and wild water birds. It can be categorised as either highly pathogenic (HPAI) or low pathogenic (LPAI) based on the molecular characteristics of the virus and its capacity to cause disease and mortality in chickens.

Poultry with LPAI may show mild or no symptoms, while HPAI causes severe illness and death. Both spread quickly through flocks, so strict biosecurity measures are crucial. LPAI can mutate into highly pathogenic strains, making prompt outbreak management vital.

1.2 | Transmission

Recently, more wild bird and mammal species have been affected by HPAI viruses, which now show signs of adapting to mammals. Animal-to-human transmission has occurred occasionally, but no human-to-human transmissions have been reported.

Avian influenza can be transmitted from animals to humans mainly in two ways:

- Directly from birds or from contaminated environments
- Through an intermediate host, such as a pig

Individuals who are exposed to potentially infected birds, including workers involved in culling operations, or those in close contact with potentially infected mammals, such as foxes or other wildlife at rehabilitation centres, must receive proper protection and be actively monitored following exposure.

There is no evidence that avian influenza can be transmitted to humans through the consumption of poultry products. Safe handling of raw meat and other raw food ingredients, thorough cooking and good kitchen hygiene practices can prevent or reduce the risks associated with contaminated food.

1.3 | Epidemiological aspects

In October 2016, highly pathogenic avian influenza (HPAI) of subtype H5N8 virus was first detected in a wild bird found deceased in Hungary. Subsequently, the virus was identified in wild birds, poultry farms and captive bird holdings (e.g. in zoos) across 19 Member States. The most affected regions were those with a high density of duck and geese holdings. Until 2020, HPAI was primarily detected in wild birds, with occasional occurrences in poultry farms.

Throughout 2020, two distinct epidemic seasons of HPAI were observed within the European Union. The first season began in December 2019 and concluded in June 2020, marked by the detection of a novel subtype (H5N8) responsible for outbreaks in Poland, Czechia, Germany, Hungary, Slovakia and Romania. The second epidemic commenced in October 2020, during which a significant number of dead and sick wild birds, predominantly migratory species, were found to be infected with HPAI viruses of subtypes H5N8, H5N5, H5N1 and H5N3. During this period, several EU countries and the United Kingdom reported these cases, and between October and December 2020, the disease was confirmed in poultry in Croatia, Denmark, France, Ireland, Germany, the Netherlands, Poland, Sweden and the United Kingdom.

The epidemic that commenced in October 2021 persisted through 2022, impacting wild birds, poultry and captive birds in 25 EU Member States. This 2021–2022 epidemic has been the largest observed in the EU to date, with the H5N1 subtype being predominantly detected. Numerous seabird species experienced extensive and severe mortality due to HPAI of the H5N1 subtype. In terms of poultry, the rapid containment of the virus proved challenging in areas with a high concentration of poultry establishments. Nevertheless, from the second quarter of 2022 onwards, the epidemiological situation began to improve, although a limited number of outbreaks continued to be detected during the summer months in areas where the virus persisted among wild birds.

The epidemic that began in September 2022 continued into 2023, affecting wild birds, poultry and captive birds in 26 EU Member States. Overall, the 2022–2023 epidemic has been less severe for poultry compared to the 2021–2022 epidemic. Since October 2022, the HPAI virus of the H5N1 subtype has been detected more frequently in mammalian species than in previous years, particularly in wild carnivores, fur farm animals, marine mammals and pets, despite these occurrences remaining relatively rare.

In addition to these identified HPAIVs over the years, low pathogenic avian influenza viruses (LPAIVs) of both A(H5/H7) and other subtypes continue to be isolated from both poultry and wild birds.

1.4 | Latest: Vaccination and risk mitigation measures

In October 2023, EFSA[3] assessed available vaccines and their efficacy against HPAI virus in poultry and provided advice about possible vaccination strategies.

In April 2024, EFSA[4] published a scientific opinion assessing the surveillance and risk mitigation measures in vaccinated areas and farms. Scientists assessed these measures and evaluated whether the available surveillance strategies could demonstrate freedom from the disease thereby enabling the safe movement of poultry and related products.

The same month, EFSA and ECDC issued a report[5] discussing the drivers for a potential pandemic of avian influenza currently in circulation worldwide. The report focuses on events such as reassortment, mutation and adaptation of avian influenza viruses to mammals, including humans.

The experts also identified a number of risk mitigation measures to be implemented under a One Health approach at national and EU level to reduce the risk of the virus evolving.

1.5 | The EU surveillance

Before 2003, the EU relied on Council Directive 92/40/EEC for control measures, but there was no explicit obligation for systematic surveillance. Surveillance and reporting were mainly focused on responding to outbreaks rather than prevention, with significant changes introduced in 2003 to address emerging risks.

Since 2003 EU Member States must carry out surveillance programmes for avian influenza aimed at early detection of HPAIVs and at detecting infections with low pathogenic avian influenza viruses of the H5 and H7 subtypes in poultry which have the potential to mutate to the highly pathogenic form of the virus.

The surveillance for avian influenza is compulsory and, in accordance with Implementing Regulation (EU) 2020/690, highly pathogenic avian influenza and infection with low pathogenic avian influenza viruses are subject to Union surveillance programmes, which are programmes relevant for the Union as a whole.

Avian influenza surveillance in poultry and wild birds must be implemented on the entire territory of all EU Member States and in accordance with the provisions laid down in Annex II to Delegated Regulation (EU) 2020/689.

In accordance with Implementing Regulation (EU) 2020/2002 Member States shall submit to the Commission every year, data on the results of the implementation of the Union surveillance programmes. The data shall be submitted electronically via the Animal Disease Information System (ADIS).

1.6 | Background and Terms of Reference as provided by the requestor

In 2017, EFSA received a mandate[6] with the Terms of Reference being to 'collect, collate, validate, analyse and summarise in an annual report the results from avian influenza surveillance carried out by Member States in poultry and wild birds.'

In the context of Article 31 of Regulation (EC) No 178/2002, from 2018 onwards, EFSA was requested to provide technical and scientific assistance to the European Commission (EC) to deliver on this mandate. This implies that EFSA has been responsible for the annual surveillance report on AI since 2018.

In addition, the collation of all data related to the surveillance activities taking place in MSs has been conducted by EFSA in a harmonised way since January 2019.

1.7 | Interpretation of the Terms of Reference

In the Annex of the mandate, the EC recalls what is the objective of the surveillance programmes in poultry and wild birds, i.e. 'to detect the prevalence of infections with avian influenza virus subtypes H5 and H7 in different species of poultry and to contribute, on the basis of a regularly updated risk assessment, to the knowledge on the threats posed by wild birds in relation to any influenza virus of avian origin in birds'.

It appears that in order to fully support the EC and the MSs in this task, a data collection focussing only on the laboratory results would hardly fit the purpose. In fact, to estimate basic parameters like prevalence and incidence, data on the target population in the different MSs are needed. Similarly, additional information on the farms, both affected and not affected, would be needed if the goal is also to contribute to the identification of potential risk factors.

[3]Vaccination of poultry against highly pathogenic avian influenza – Available vaccines and vaccination strategies (https://www.efsa.europa.eu/en/news/vaccination-poultry-against-highly-pathogenic-avian-influenza-available-vaccines-and).

[4]Vaccination of poultry against highly pathogenic avian influenza – Part 2. Surveillance and mitigation measures (https://www.efsa.europa.eu/en/efsajournal/pub/8755).

[5]Avian influenza: One Health surveillance is key to prevent virus evolving (https://www.efsa.europa.eu/en/news/avian-influenza-one-health-surveillance-key-prevent-virus-evolving).

[6]https://open.efsa.europa.eu/questions/EFSA-Q-2023-00579?foodDomains=Animal+Health&search=avian+influenza.

1.8 | Additional information

In occasion of the Standing Committee on Plants, Animals, Food and Feed (PAFF) meeting on Animal Health, held in Brussels in December 2023, some of the participants pointed out that reporting only the results originating from the surveillance activities in the EFSA output has limited usefulness and may even lead to wrong conclusions by a reader which is not in the field. All the participants agreed that a comprehensive report, in which all the testing activities and related results are gathered and presented together, would be more informative.

This report, also thanks to the introduction of the SIGMA approach[7] for the collection of the avian influenza data and poultry population data, is the first attempt to further improve the outputs, with the inclusion of additional statistics.

2 | DATA AND METHODOLOGIES

2.1 | Data

EFSA is in charge of the data collection since 2019. The data are submitted by the Reporting Countries (RCs) via the EFSA Data Collection Framework (EFSA DCF). Optionally, the RCs can make use of the SIGMA EST web application for the automated translation of the national data into EFSA standard data. Once submitted into the EFSA DCF, the data undergo a series of business rules for the identification of potential inconsistencies, and, in case of errors, the data are rejected for correction. When the data are correct, they are then migrated to the EFSA scientific data warehouse. From that moment, each Reporting Country (RC) can visualise its submitted data by means of Validation Dashboards, created with MicroStrategy and check for consistency. If the summary tables, the graphs and the maps included in the dashboards reflect the actual situation in the country, the data validator can accept the data. With this action, EFSA is authorised to deal with these data as official.

In 2024, the SIGMA approach[8] was implemented for the first time to collect the data originating from the **laboratory testing activities performed in 2023** and the **target poultry population data**.

The main novelties introduced were:

- **The data model on poultry population (EFSA**, 2022**; EFSA**, 2022[9]**)**
    - For the first time, the RCs were asked to submit poultry population data
- **The revised SSD2 data model on laboratory results for the detection of the Avian Influenza virus** (EFSA, 2024[10]**)**
    - Resolution at sample/result level for all samples (negative and positive, poultry and wild birds)
    - Distinction between animal species and purpose of raising, even in case commercial terms are used (e.g. broilers).

2.1.1 | Population data

Eighteen RCs (out of 33 countries potential data providers) submitted poultry data (see Figure 1). These data were submitted on a voluntary basis by Belgium, Cyprus, Czechia, Denmark, Estonia, Finland, France, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, North Macedonia, Northern Ireland, Norway, Spain and Switzerland.

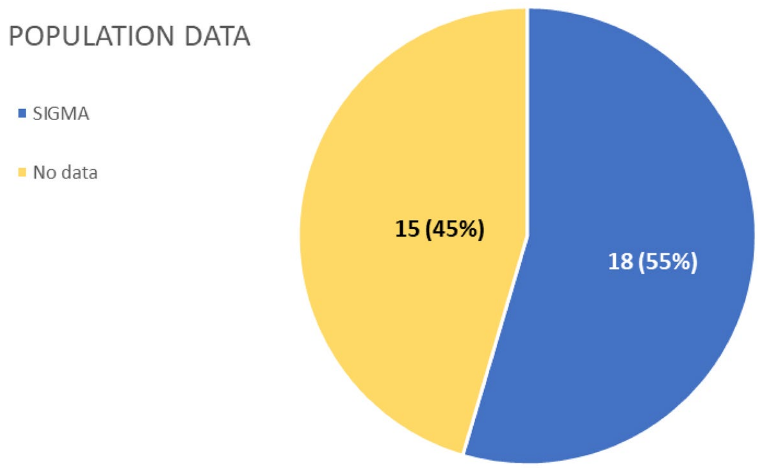

FIGURE 1 Number and proportion of countries submitting poultry population data.

[7]https://www.efsa.europa.eu/en/topics/topic/animal-health-data-collection-sigma.
[8]https://www.efsa.europa.eu/en/topics/topic/animal-health-data-collection-sigma.
[9]https://www.efsa.europa.eu/en/supporting/pub/en-7568.
[10]https://www.efsa.europa.eu/it/supporting/pub/en-8629.

2.1.2 | Laboratory data

All RCs were able to fulfil the deadlines and submit the data following the EFSA standards. Three countries (Italy, Luxembourg and the Netherlands) could not align to the new standards and reported the data using the previous standards. From 2025 all data will be submitted following the SIGMA standards.

Twenty-seven MSs, Iceland, Norway, Switzerland and the United Kingdom (Northern Ireland) reported results from their surveillance activities in 2023. Regarding the standards adopted (see Figure 2), out of the 33 countries, 27 countries (82%) submitted data using the new SIGMA-SSD2 standards; one country (Cyprus) submitted data in line with the new standards only for wild birds, while the laboratory data on poultry testing were submitted using the previous standards; three countries (9%) used the previous standards; and two countries did not provide data on 2023 surveillance activities (Montenegro and North Macedonia).

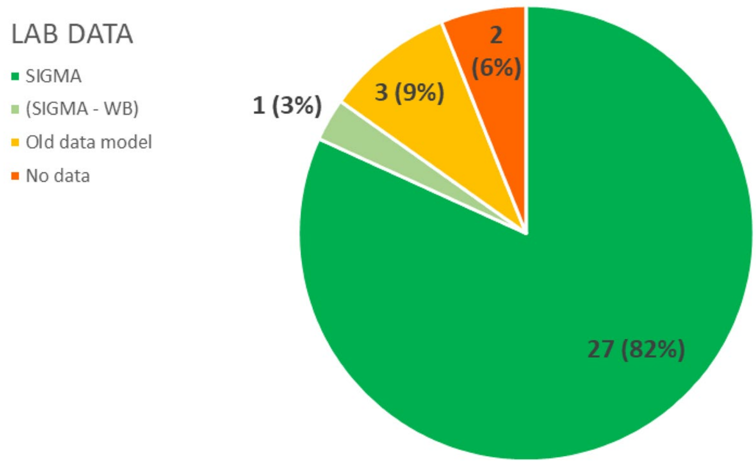

FIGURE 2 Number and proporiton of countries submitting laboratory data, with details on the standards used.

The positive serological and virological results presented here are those that were reported to EFSA in the framework of the Union Programme. Some other positive results in poultry that were detected as part of passive surveillance **may not have been reported here or not consistently by all countries**. To make this report more comprehensive, **all positive findings in poultry as reported in ADIS and in the monitoring reports will be included in a dedicated section** (see Section 5).

2.1.3 | The coexistence of two data standards

The SIGMA approach introduces standards that collect data at a more detailed level (i.e. result level) compared to the previous data model, which used a different level of aggregation. To create a unified data frame encompassing all data submitted by reporting countries, the data following the SIGMA standards were retroactively transformed and integrated with data submitted by Italy, Luxembourg, The Netherlands and Cyprus, specifically concerning laboratory data on poultry.

Nonetheless, some of the figures in the report could only be produced for those MSs reporting data using the SIGMA standards.

When describing the sampling activities of the RCs, as new categories were available in the SIGMA standards, each sample was classified as part of 'active surveillance' and 'passive surveillance' as follows, independently from the targeted domain (poultry sector or wild birds):

- ACTIVE – samples collected from animals belonging to the following categories:
  - 'Alive',
  - 'Alive without clinical signs',
  - 'Slaughtered',
  - 'Sentinel',
  - 'Hunted without clinical signs',
  - 'Hunted'
- PASSIVE – samples collected from animals belonging to the following categories:
  - 'Alive with clinical signs (including injured)',
  - 'Hunted with clinical signs (including injured)'
  - 'Dead Non-symptomatic',
  - 'Dead Symptomatic',

- ‘Found dead’,
- ‘Culled’,
- ‘Trapped with clinical signs (including injured)’

This classification, despite some new categories, is substantially in line with the previous classification.

2.2 | Methodologies

2.2.1 | Tools and software

The tool for the validation of the data used by EFSA was MicroStrategy.

For the generation of tables with data aggregated at different level (e.g. sample level, farm level, etc.) to facilitate the count of positive and negative results and for the generation of all the statistics and the data modelling the software R was used (R Core Team, 2024).

2.2.2 | Data manipulation

To ensure continuity with the previous reports, the data following the previous standards and the ones in line with the new SIGMA-SSD2 standards were aggregated to reproduce the same data environment as before. In this way, it was possible to reproduce the same statistics produced in the previous scientific reports.

The results shown in Sections 3 and 4 will be mainly based on data following the standards in place before the adoption of the SIGMA approach (i.e. the SIGMA-SSD2 data back-transformed and the data following the previous standards, joint together), and on data submitted following the standards introduced by the SIGMA approach, which include all RCs but Italy, Luxembourg the Netherlands and Cyprus (the latter with reference to the poultry sector only).

3 | POULTRY SECTOR

3.1 | Domestic (poultry) population data

Eighteen RCs submitted data on Establishments present in their territory at NUTS3 level (Nomenclature of Territorial Units for Statistics, level 3. See Eurostat website for more information on NUTS areas). As Belgium could not provide information at the desired level of resolution, the data were accepted with a resolution at NUTS2 level.

Table 1 lists for each RC the type of Establishment reported. The 18 countries made different choices about the type of Establishments to be submitted to EFSA, but all of them reported the ‘Farm’ type, on which the epidemiological considerations are normally conducted and from which the majority of the samples are collected. Nonetheless, Establishments like Markets or Slaughterhouses could play a role or could represent an interesting point of sampling. With these data available, new aspects will be investigated and, possibly, included in the future reports, if relevant.

TABLE 1 Type of Establishments reported by the 18 RCs. The Establishments in bold are included in the category ‘Commercial Establishments’ in the following maps, tables and plots.

Reporting Country*	Type of establishment submitted
BE	**Farm, Hatchery**
CH	**Farm**
CY	**Farm**
CZ	**Farm**
DK	**Farm**, **Hatchery**, Slaughterhouse
EE	**Farm, Genetic centre**
ES	**Farm, Genetic centre**, Market, Slaughterhouse, Health and Research Centre, **Hatchery**, Quarantine premises, Exhibition, Pasture-Co-Pasture
FI	**Farm, Hatchery**
FR	**Farm**
IE	**Farm**
IS	**Farm**, Slaughterhouse, **Hatchery**, Quarantine premises

TABLE 1 (Continued)

Reporting Country*	Type of establishment submitted
IT	**Farm**
LT	**Farm**, Slaughterhouse, **Hatchery**
LV	**Farm**
MK	**Farm**
MT	**Farm**
NO	**Farm**, Slaughterhouse, **Hatchery**
XI	**Farm**

*XI: United Kingdom (Northern Ireland).

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

For other country codes, please refer to EUROSTAT.

Figure 3 shows the distribution/density of the reported Establishments per NUTS3 area. The Establishments counted belong to the super-category '**Commercial Establishment**', i.e.:

- **Farm Establishments**, excluding farms producing for own consumption (backyards), zoos and laboratories dealing with animals (veterinary clinics, hospitals, Research centres, etc.)
- **Hatcheries**
- **Genetic centres**

All animal species are included.

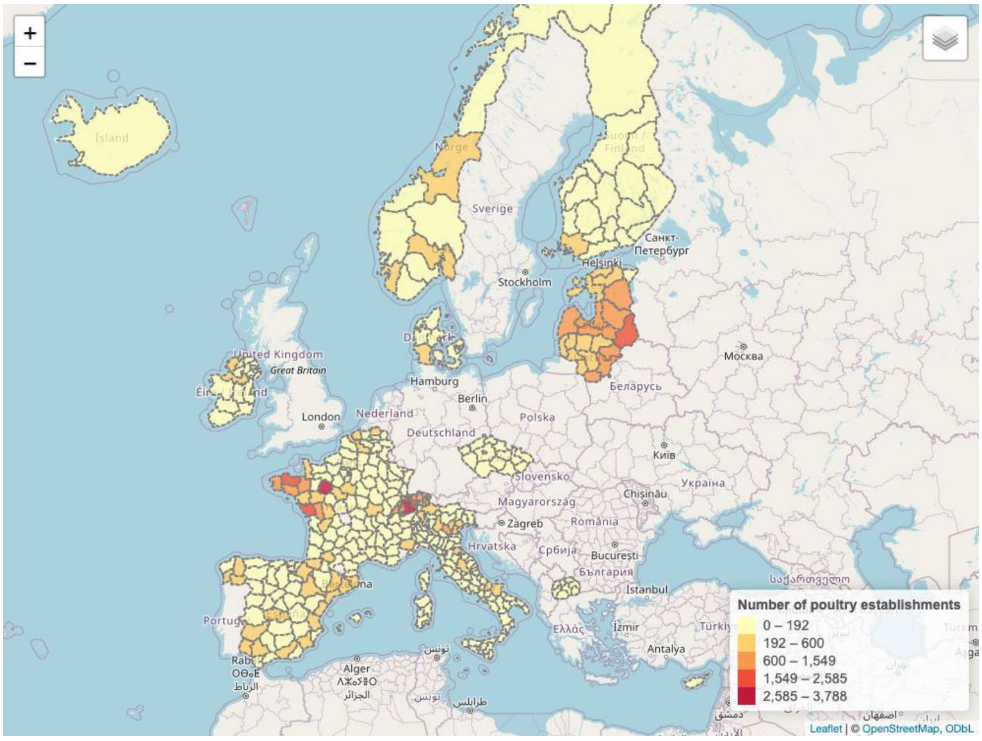

FIGURE 3 Geographical distribution/density of Commercial Establishment, per NUTS3 or NUTS2 region, depending on the level provided, across the 18 RCs that submitted population data on a voluntary basis.

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

Table 2 reports the number of Commercial Establishments (column 1); the number of Commercial Sub-units (i.e. the number of physical buildings within an Establishment, column 2); Farm Establishments producing for own consumption ('backyards', column 3); the number of Establishments other than Commercial and backyards; and the total number of sub-units (column 4). In some cases the number of Establishments and related sub-units are the same (e.g. France, Ireland, Latvia, Lithuania, Malta, North Macedonia and United Kingdom (Northern Ireland)). This could indicate a relationship 1:1 between Establishment and sub-unit or a lack of identifiers at sub-unit level, making impossible to report the actual number of sub-units in each Establishment. For this reason, and for other epidemiological considerations, it was agreed to perform the analysis at Establishment level, making also easier to create the link with the laboratory data, where the official Establishment Identifier is recorded.

Additional maps, illustrating the geographical distribution of the different type of Establishments (e.g. Hatcheries, Slaughterhouses, etc.) are available in Zenodo.[11]

TABLE 2 Number of Commercial Establishments, Commercial sub-units, Backyards and other type of Establishments not included in the previous categories. The counting is performed for the 18 RCs that submitted data following the SIGMA-SSD2 standards.

	Number of Commercial Establishments[a]	Number of Commercial sub-units[b]	Number of Establishments for Own Consumption (Backyards)	Number Of other type of Establishment[c]
BE	1589	3373	197	0
CH	16,452	18,597	0	0
CY	58	58	0	0
CZ	336	389	0	0
DK	835	1743	0	0
EE	1907	2575	0	0
ES	7934	8676	9495	15
FI	1415	1923	8266	0
FR	18,971	18,971	0	0
IE	871	871	0	0
IS	52	61	0	0
IT	8416	22,444	15,454	0
LT	5137	5137	0	0
LV	5470	5470	0	0
MK	56	56	0	0
MT	80	80	0	0
NO	1221	1229	0	0
XI	68	68	1	0
Total	70,868	91,721	33,413	15

XI: United Kingdom (Northern Ireland).

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

[a]Establishment: as per definition in the AHL, i.e. any premises, structure or, in the case of open-air farming, any environment or place, where animals or germinal products are kept, on a temporary or permanent basis, except for: (a) households where pet animals are kept and (b) veterinary practices or clinic.

[b]Subunit: as per definition in the EFSA Guidance for reporting poultry population and avian influenza data, i.e. a management group of animals of the same animal species, sharing the same geographical location and the same rearing purpose in the context of a given establishment.

[c]Other types of Establishments, namely: Exhibition, Hatchery, Health and Research Centre, Market, Pasture-Co-Pasture, Quarantine premises, Slaughterhouse.

Figure 4, as an example, illustrates the number and the distribution at NUTS3 level, across the 18 RCs, of the animals of the species *Gallus gallus*, reared in Commercial Establishments. The geographical distribution of the other poultry species can be found in Zenodo.[12]

For the correct interpretation of these figures and illustrations, it is important to note that the data submitted by the RCs represent the situation at a specific moment in time (i.e. a 'snapshot' at a given moment in time). This means that the number of animals that are bred in 1 year time is not captured or, in other words, the production cycle is not taken into account.

[11]https://zenodo.org/uploads/14415846.

[12]https://zenodo.org/uploads/14415846.

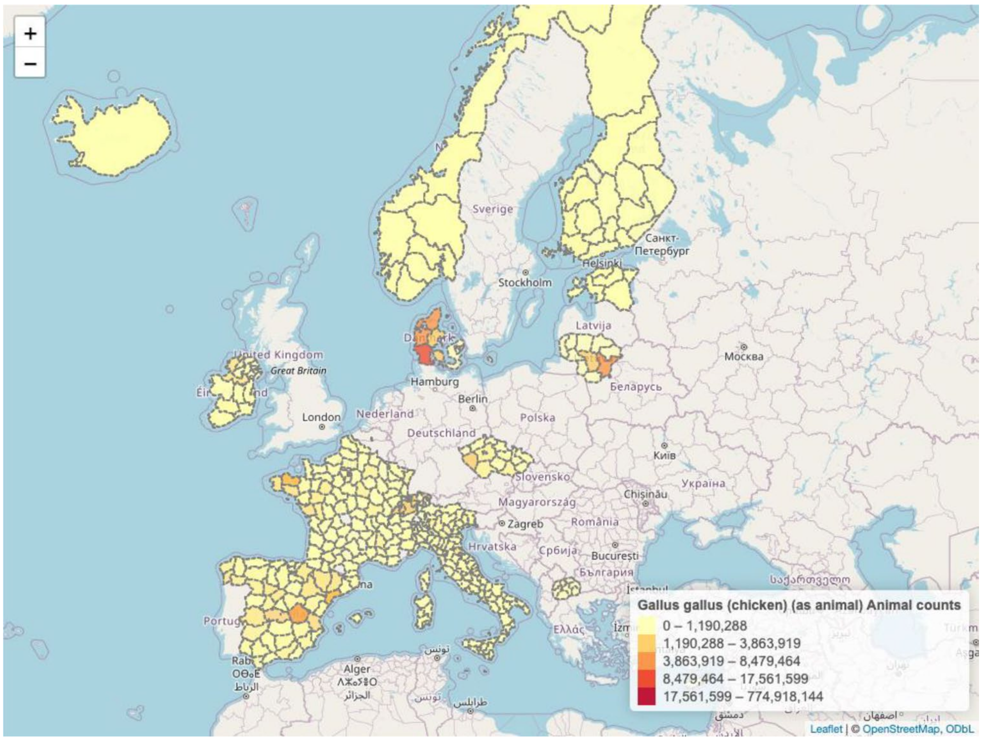

FIGURE 4 Geographical distribution, per NUTS3 region, across the 18 RCs that submitted data using the SIGMA-SSD2 standards, of the number of animals belonging to the *Gallus gallus* species, reared in Commercial Establishments. The countries that did not submit data on poultry population are not coloured.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

The map makes easy to identify those areas where the concentration of *Gallus gallus* animals is higher, showing Denmark and Lithuania as the countries with the highest number of animals in their NUTS3 regions. These regions are followed by the ones in Spain, bordering the Pyrenees and in the center of the country (from Extremadura to Valencia), and by those in Brittany (France). Switzerland is also a country where this species is well represented, as in the region of Plzen (Czechia).

Table 3 provides an overview of the number of Sub-units per poultry species and per purpose of raising. A distinction has been made between the sub-units pertaining to commercial farming and sub-units having 'own consumption' as production goal.

The farming of broilers (*G. gallus* – Meat) represents the most diffuse type across the 18 RCs.

G. gallus is also the species for which the highest number of Sub-units were reported overall (12 times the number of Sub-units rearing Turkeys). From a production type perspective, ~30% poultry species are bred to produce meat.

In Table 4, the number of animals per species and related purpose of raising are shown. This perspective confirms what observed at sub-unit level: the top position among the species remains with *G. gallus*, while the most represented production goal is represented by the meat.

TABLE 3 Number of sub-units, pertaining to Commercial Establishments and sub-units producing for own consumption (backyards) per species and purpose of raising.

	COMMERCIAL ESTABLISHMENTS Number of sub-units										OWN CONSUMPTION ESTABLISHMENTS Number of sub-units
	NA*	Meat	Eggs	Breeding	Growers	Game	Mixed	Foie gras	Feather	Total	
***Gallus gallus* (chicken)**	21,062	21,981	14,306	3215	609	2	349	0	5	**77,950**	16,421
Generic poultry	5482	4071	29	15	278	240	0	0	0	**26,353**	16,238
Galliformes	405	5928	0	53	0	12	0	0	0	**6398**	0
Turkey	833	4017	63	575	12	0	32	0	1	**6271**	738
Duck	1258	1314	186	353	12	2	76	385	3	**5004**	1415
Goose	1286	120	86	53	4	0	62	6	2	**2205**	586
Quail	474	243	220	84	8	47	29	0	0	**1613**	508
Pigeon	41	141	8	60	0	33	1	0	0	**1239**	955
Helmeted Guineafowl	177	315	17	21	12	0	5	0	0	**596**	49
Pheasant	195	40	22	33	0	100	3	0	0	**573**	180
Partridge	23	53	5	37	0	259	0	0	0	**549**	172
Ostrich	48	85	8	9	0	0	1	0	0	**166**	15
Mallard	21	5	1	16	0	5	0	0	0	**53**	5
Muscovy Duck	0	2	3	3	0	0	0	0	0	**27**	19
Emu	21	0	0	0	0	0	0	0	0	**26**	5
Nandu	1	0	0	0	0	0	0	0	0	**5**	4
Anseriformes	3	0	0	0	0	0	0	0	0	**3**	0
Southern Cassowary	0	0	0	0	0	0	0	0	0	**1**	1
Total	**31,330**	**38,315**	**14,954**	**4527**	**935**	**700**	**558**	**391**	**11**	**129,032**	**37,311**
	24.28%	**29.69%**	**11.59%**	**3.51%**	**0.72%**	**0.54%**	**0.43%**	**0.30%**	**0.01%**		

*The purpose of raising was not specified in the data submitted.

TABLE 4 Number of animals per species bred in Commercial Establishments and Establishments producing for own consumption (backyards) per species and purpose of raising.

	COMMERCIAL ESTABLISHMENTS Number of animals									TOTAL	OWN CONSUMPTION ESTABLISHMENTS Number of animals
	NA*	Meat	Eggs	Breeding	Growers	Game	Mixed	Foie gras	Feather		
***Gallus gallus* (chicken)**	905,347,642	419,374,957	165,665,387	38,006,830	4287	0	805,948	84,672	329	**1,532,882,586**	3,592,534
Galliformes	3412	67,984,043	0	854,360	125,720	0	0	0	0	**68,967,535**	0
Turkey	5,593,278	24,086,463	181,960	2,158,715	0	0	4792	102	20	**34,129,364**	2,104,034
Quail	13,615,680	6,937,715	881,536	549,471	19,452	0	0	41,416	0	**22,153,784**	108,514
Duck	128,265	7844,302	105,417	1314,564	8350	1,318,740	707	493	28	**10,831,085**	110,219
Generic poultry	6,155,328	3,025,471	0	0	0	0	0	0	0	**9,181,847**	1048
Partridge	7,143,882	189,869	3360	306,614	1,459,506	0	0	0	0	**9,115,617**	12,386
Pheasant	380,058	63,774	80,494	34,390	201,425	0	0	0	0	**810,927**	50,786
Helmeted Guineafowl	1282	303,370	181	57,727	0	0	0	30	0	**362,952**	362
Mallard	110,340	13,600	4000	27,201	42,500	0	0	0	0	**210,661**	13,020
Goose	13,554	35,757	9956	44,184	0	3139	0	339	25	**210,023**	103,069
Pigeon	1833	48,811	215	13,432	20,818	0	0	19	0	**115,308**	30,180
Ostrich	761	1430	21	23	0	0	0	2	0	**2277**	40
Muscovy Duck	0	25	60	60	0	0	0	0	0	**256**	111
Emu	50	0	0	0	0	0	0	0	0	**55**	5
Anseriformes	15	0	0	0	0	0	0	0	0	**15**	0
Nandu	3	0	0	0	0	0	0	0	0	**3**	0
Southern Cassowary	0	0	0	0	0	0	0	0	0	**0**	0
Total	**938,495,383**	**529,909,587**	**166,932,587**	**43,367,571**	**1,882,058**	**1,321,879**	**811,447**	**127,073**	**402**	**1,688,974,295**	**6,126,308**
	55.57%	**31.37%**	**9.88%**	**2.57%**	**0.11%**	**0.08%**	**0.05%**	**0.01%**	**0.00%**		

*The purpose of raising was not specified in the data submitted.

Figure 5 helps visualising the importance of the poultry production (number of Sub-units) across the 18 RCs in terms of species bred, while Figure 6 shows the magnitude of the production type.

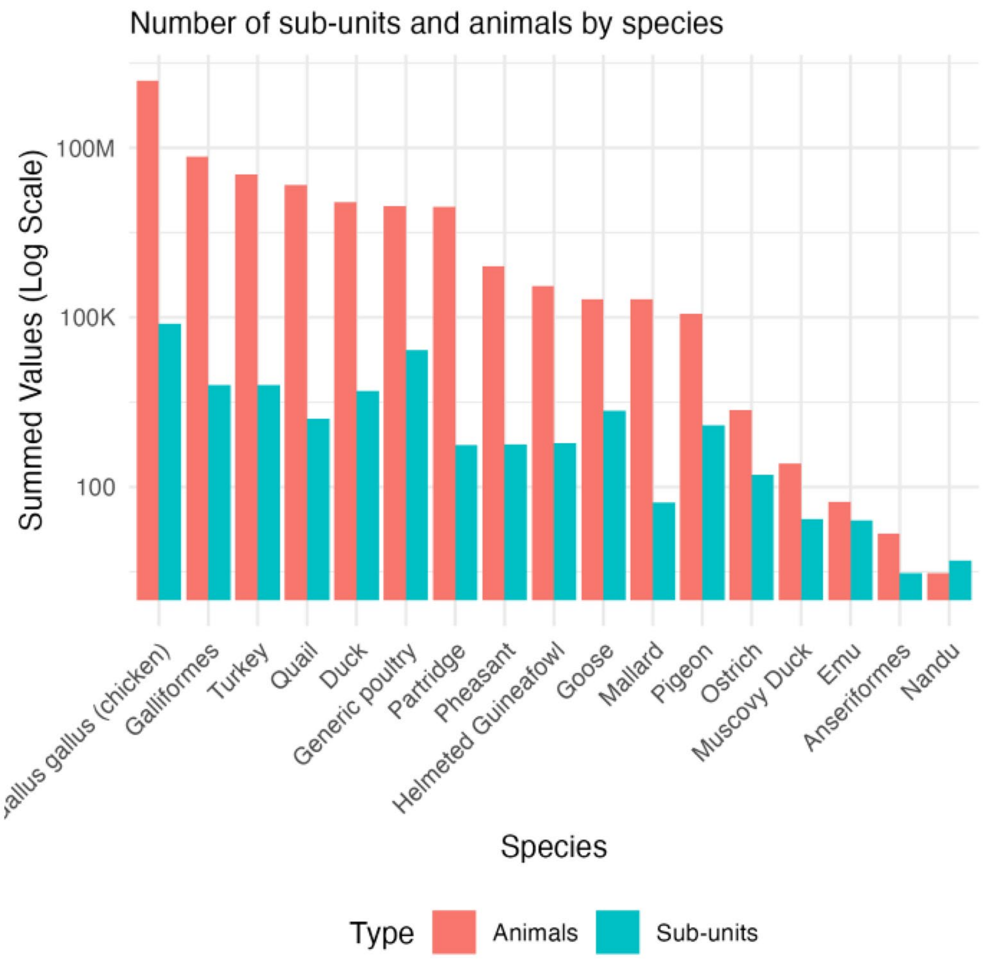

FIGURE 5 Commercial Establishments and Establishments producing for own consumption (backyards): Number of Animals (red bars) and number of Sub-units (green bars) per species. The count is performed on the data submitted by the 18 RC following the new SIGMA-SSD2 standards.

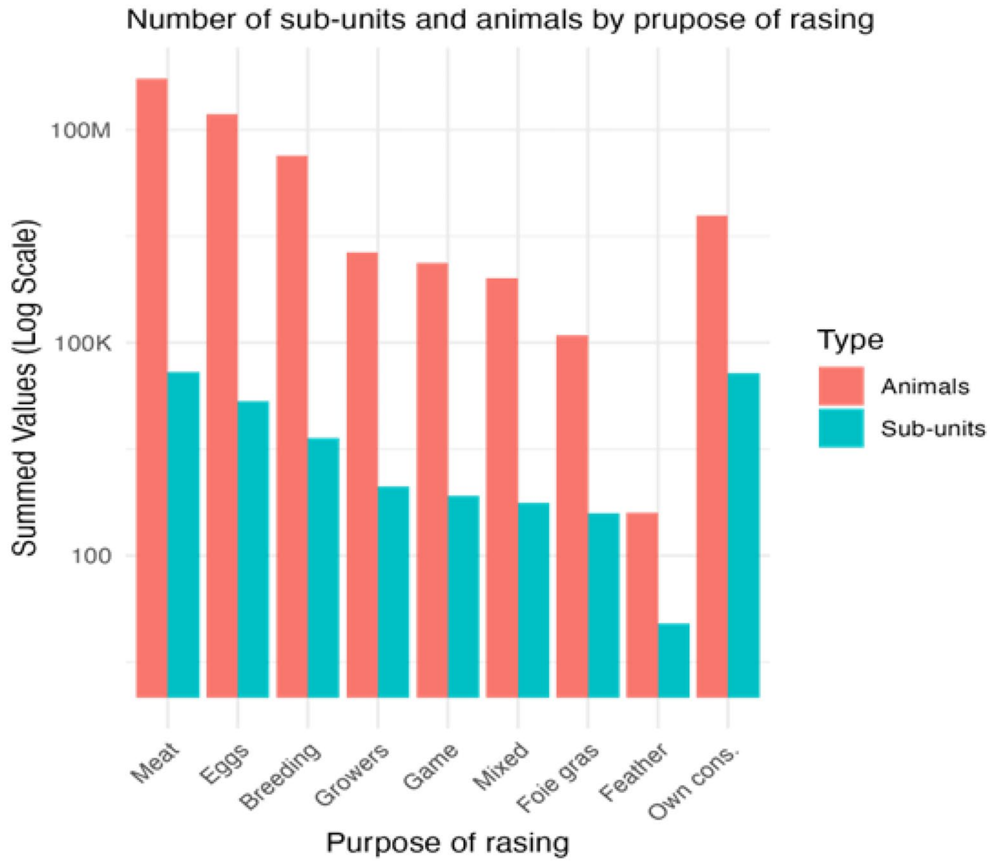

FIGURE 6 Number of sub-units per poultry species across the 18 RCs that submitted data following the new SIGMA-SSD2 standards. Commercial Establishments and Establishments producing for own consumption (backyards): Number of Establishments (blue bars) and number of animals (green bars) per purpose of raising.

3.2 | Sampling in poultry

3.2.1 | Overview of the poultry sampling activities

The total number of PEs sampled in 2023 were 21,183. Sampling is mainly done under European funding ('EU co-funded active surveillance' in Figure 7). However, Hungary, Iceland, Norway, Romania and Switzerland also reported surveillance results from their national programmes (non-EU co-funded programmes), and Iceland also reported results obtained by private industry sampling (Figure 3). Croatia, Denmark, Malta, Slovenia and the United Kingdom (Northern Ireland) didn't specify the programme type under which their surveillance result fell.

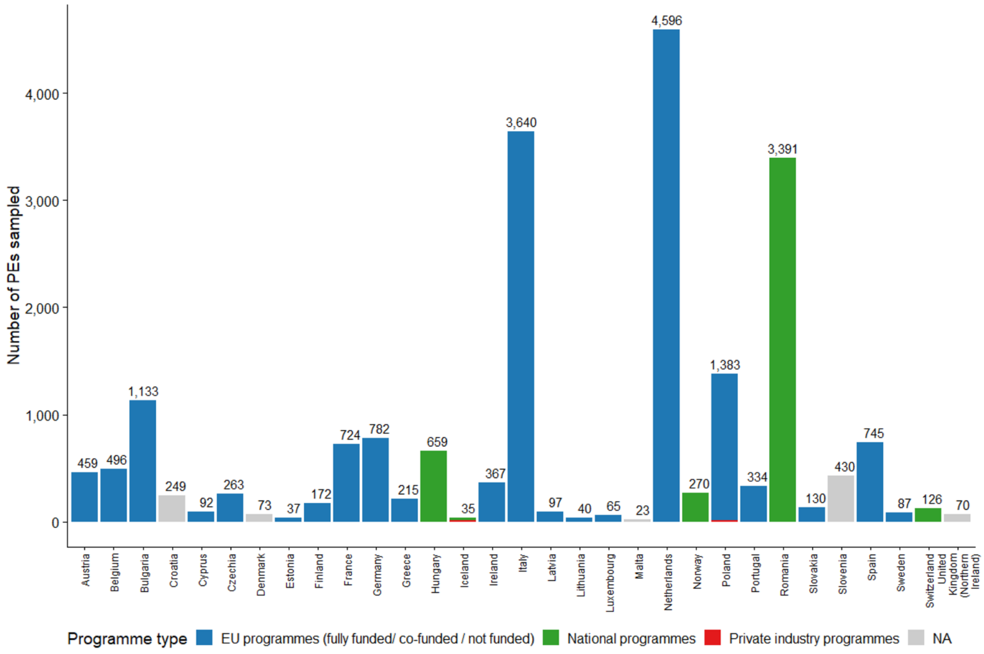

FIGURE 7 Number of PEs sampled by RCs in 2023 according to the type of surveillance programme for which results were reported to EFSA. (NA = not specified in the data).
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

In 2023, the number of PEs sampled per country is in line with what was observed in 2022. Exceptions are Bulgaria, Hungary, Norway, Poland and Slovenia, which had an increase in the number of PEs surveyed, and Belgium, Denmark, Estonia, France, Spain, Sweden and the United Kingdom (Northern Ireland) which reported a lower number of PEs compared to last year.

Virological and serological surveys presented high diversity across countries and species categories. This diversity is expected in any risk-based surveillance system. This diversity is illustrated by Figure 8, Figure 9 and Figure 10 for the **serological survey** and by figures from Figure 11 to Figure 14 for the **virological survey**. Please note that these figures were developed from the data submitted following the new SIGMA-SSD2 standards: Italy, Luxembourg, The Netherlands and Cyprus are therefore not included. For a comprehensive picture, including all of the RCs, please refer to Appendix A.

The majority of the RCs used both virological and serological surveys. Some used only one: Denmark, Estonia, Hungary, Lithuania and the United Kingdom (Northern Ireland) collected samples only using virological surveys, while Austria, Belgium, Cyprus, Ireland, Malta, Romania and Switzerland only used serological surveys.

It should be noted that the figures presented in the subsequent paragraphs include additional commercial categories beyond those mentioned in previous legislation. These categories are derived from combining information elements submitted by countries adhering to the SIGMA-SSD2 standards, specifically by integrating the animal species with the purpose of raising. Consequently, certain categories may be listed due to the absence of the purpose of raising in the submission. Examples of such categories include 'chickens', 'turkeys' and 'ducks'.

	Gallus gallus (chicken) (as animal)_Egg production purpose	Turkey (as animal)_Meat production purpose	Gallus gallus (chicken) (as animal)_Breeding purpose	Turkey (as animal)_Breeding purpose	Gallus gallus (chicken) (as animal)_Not Available	Duck (as animal)_Meat production purpose	Gallus gallus (chicken) (as animal)_Meat production purpose	Goose (as animal)_Meat production purpose	Duck (as animal)_Breeding purpose	Turkey (as animal)_Not Available	Goose (as animal)_Breeding purpose	Duck (as animal)_Not Available	Gallus gallus (chicken) (as animal)_Growers	Ostrich (as animal)_Meat production purpose	Pheasant (as animal)_Not Available	Quail (as animal)_Not Available	Pigeon (as animal)_Not Available	Quail (as animal)_Egg production purpose	Goose (as animal)_Not Available	
	Laying Hens	Fattening Turkeys	Breding Chickens	Bredeing Turkeys	Chickens	Fattening Ducks	Broilers	Fattening Geese	Breeding Ducks	Turkeys	Breeding Geese	Ducks	Grower Chickens	Fattening Ostriches	Pheasants	Quails	Pigeons	Laying Quails	Geese	
AT	256	49	29			29	1	45						2						411
BE					395					26		12			12					445
BG	53		16	1	1	172	3		6			11					1			264
CH					94					28										122
CZ					83					43		2								128
DE	18	128	8	1		152	13	141	15		1			23						500
ES	164	68	122	5		38	3	16	2		2					17	14			451
FI	71	48	34	3		1	3	1												161
FR		1		3					66		25									95
GR	93	21	41	3			14						26							198
HR					226					14										240
IE	89	7	95	5		17	41	1	4		2									261
IS					18					6										24
LV					91															91
MT					22															22
NO	78	38	7	3		1		1	2											130
PL	241	177	162	19		135	1	141	39		14							4		933
PT	9	65																		74
RO	189	17	41										3					4		254
SE	6	34	30	3								3							3	79
SI	94	33	7			15														149
SK					61					21		6			9	2			1	100
	1361	686	592	46	991	560	79	346	134	138	44	34	29	25	21	19	15	8	4	5132
	13	13	12	10	9	9	8	7	7	6	5	5	2	2	2	2	2	2	2	

FIGURE 8 Total number of Commercial Establishments sampled by at least two countries for serology, presented by RCs and poultry category. The colours indicate the poultry categories with the smallest (lightest red shade) to the largest (darkest red shade) number of Establishments sampled. The two grey rows at the bottom report the total number of Establishments sampled for each specific category and the number of countries that targeted it. Note: The counting was performed only for the 27 RCs that adopted the SIGMA-SSD2 standards.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland.

Concerning serological surveys, 22 countries (out of the 27 submitting data using the SIGMA-SSD2 standards) reported the results of the testing conducted in the poultry sector. The most frequently targeted commercial poultry categories (i.e. tested by the largest number of RCs), as described in Figure 8, were conventional laying hens ($n = 13$), fattening turkeys ($n = 13$), breeding chickens ($n = 12$) and breeding turkeys ($n = 10$). Only two countries reported sample collection from growers,[13] i.e. Greece and Romania. Among the commercial poultry categories selected by only one country (see Figure 9), the ducks and the geese kept for the production of foie gras are the most sampled: 241 and 38 establishments sampled, respectively.

[13]For the purpose of this report, growers are defined as PEs (different species) in which poultry are reared for only part of their productive cycle, production cycle, while they will later be sold to other farms for the completion of their production cycle (i.e. meat/eggs) (Brouwer et al., 2018).

	Duck (as animal)_Foie gras production purpose	Anseriformes (as animal)_Mixed purposes	Goose (as animal)_Foie gras production purpose	Partridge (as animal)_Not Available	Anseriformes (as animal)_Meat production purpose	Pheasant (as animal)_Meat production purpose	Gallus gallus (chicken) (as animal)_Mixed purposes	Quail (as animal)_Mixed purposes	Turkey (as animal)_Growers	Turkey (as animal)_Egg production purpose	Quail (as animal)_Meat production purpose	Ostrich (as animal)_Not Available	Duck (as animal)_Egg production purpose	Generic poultry (as animal)_Growers	
	Foie Gras Ducks	Mixed Anser	Foie Gras Geese	Partridges	Fattening Anser	Fattenint Pheasants	Mixed Chickens	Mixed Quails	Grower Turkeys	Laying Turkeys	Fattening Quails	Ostriches	Laying Ducks	Grower Poultry	
AT															0
BE				4											4
BG							2	2					1		5
CH															0
CZ															0
DE		61													61
ES															0
FI															0
FR	241		38												279
GR									2					1	3
HR															0
IE															0
IS															0
LV															0
MT															0
NO															0
PL										2					2
PT											2				2
RO					3	3						2			8
SE															0
SI															0
SK															0
	241	61	38	4	3	3	2	2	2	2	2	2	1	1	364
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

FIGURE 9 Total number of Commercial Establishments sampled by only one country for serology, presented by RCs and poultry category. The colours indicate the poultry categories with the smallest (lightest red shade) to the largest (darkest red shade) number of Establishments sampled. The two grey rows at the bottom report the total number of Establishments sampled for each specific category and the number of countries that targeted it (in this case, only one). The counting was performed only for the 27 RCs that adopted the SIGMA-SSD2 standards.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland.

For what concerns the game and non-commercial establishments (see Figure 10) the most targeted are those breeding pheasants for game purposes: six countries selected this category, for a total of 84 establishments. Overall, the game establishments seem to be a preferred target compared to the backyard farms, although the total number of sampled farms remains considerable (1271 backyards sampled in 2023).

	Pheasant (as animal)_Game purpose	Galliformes (as animal)_Game purpose	Mallard (as animal)_Game purpose	Gallus gallus (chicken) (as animal)_For own consumption	Generic poultry (as animal)_For own consumption	Partridge (as animal)_Game purpose	Anseriformes (as animal)_For own consumption	Galliformes (as animal)_For own consumption	Duck (as animal)_For own consumption	Anseriformes (as animal)_Game purpose	Quail (as animal)_Game purpose	
	Game Pheasants	Game Galliformes	Game Mallards	Backyard Chickens	Backyard Poultry	Game Partridges	Backyard Anser	Backyard Galliform	Backyard Ducks	Game Anser	Game Quails	
AT												0
BE					47							47
BG	4			1								5
CH												0
CZ	27											27
DE												0
ES		189			15					37		241
FI	8		3									11
FR	39	3	15			7						64
GR		3										3
HR												0
IE	3											3
IS												0
LV												0
MT												0
NO				1								1
PL				1							33	34
PT												0
RO							613	516				1129
SE			5									5
SI	3					1			76			80
SK												0
	84	195	23	3	62	8	613	516	76	37	33	1650
	6	3	3	3	2	2	1	1	1	1	1	

FIGURE 10 Total number of Game Establishments and Non-Commercial Establishments sampled for serology, presented by RCs and poultry category. The colours indicate the poultry categories with the smallest (lightest red shade) to the largest (darkest red shade) number of Establishments sampled. The two grey rows at the bottom report the total number of Establishments sampled for each specific category and the number of countries that targeted it. The counting was performed only for the 27 RCs that adopted the SIGMA-SSD2 standards.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland.

Concerning virological surveys, 21 countries (out of the 27 submitting data using the SIGMA-SSD2 standards) reported the results of the testing conducted in the poultry sector. The most frequently targeted commercial poultry categories (i.e. tested by the largest number of RCs), as described in (Figure 11), were 'chickens' (selected by 10 countries for a total of 362 sampled establishments), 'ducks' (10 countries, 293 sampled establishments) and 'geese' (9 countries, 206 sampled establishments). Germany and France were the only countries that reported sample collection from breeding turkeys.

	Chickens	Ducks	Geese	Laying Hens	Breeding Chickens	Breeding Ducks	Fattening Turkeys	Turkeys	Fattening Ducks	Broilers	Fattening Geese	Pigeons	Breeding Geese	Pheasants	Quails	Breeding Turkeys	
	Gallus gallus (chicken) (as animal)_Not Available	Duck (as animal)_Not Available	Goose (as animal)_Not Available	Gallus gallus (chicken) (as animal)_Egg production purpose	Gallus gallus (chicken) (as animal)_Breeding purpose	Duck (as animal)_Breeding purpose	Turkey (as animal)_Meat production purpose	Turkey (as animal)_Not Available	Duck (as animal)_Meat production purpose	Gallus gallus (chicken) (as animal)_Meat production purpose	Goose (as animal)_Meat production purpose	Pigeon (as animal)_Not Available	Goose (as animal)_Breeding purpose	Pheasant (as animal)_Not Available	Quail (as animal)_Not Available	Turkey (as animal)_Breeding purpose	
BG		4		37	3	8	1		126	11		1					191
CZ		73	29					1									103
DE				3	4	1	4		1		2					1	16
DK	1	18	4											2			25
EE	17	1	1									1					20
ES				4	2		7		13	1	2		1		3		33
FI											1						1
FR				112	54	3	53									59	281
GR																	0
HR	2	1	4														7
HU	236	173	156					71						21			657
IS	2											2					4
LT	23							17									40
LV	6																6
NO				8	13	2				1			1				25
PL	9	14	6	11	1	9	42	6	57	33	38	11	28				265
PT						2			26						4		32
SE		2	2														4
SI				46	5		2			34	3						90
SK	12	2	3					1				1			1		20
XI	54	5	1					6						4			70
	362	293	206	221	82	25	109	102	223	80	46	16	30	27	8	60	1890
	10	10	9	7	7	6	6	6	5	5	5	5	3	3	3	2	

FIGURE 11 Number of Commercial Establishments sampled in 2023 for virology (Part 1/2), presented by RCs and poultry category. The colours indicate the poultry categories with the smallest (lightest blue shade) to the largest (darkest blue shade) number of Establishments sampled. The two grey rows at the bottom report the total number of Establishments sampled for each specific category and the number of countries that targeted it. The counting was performed only for the 27 RCs that adopted the SIGMA-SSD2 standards.
XI: United Kingdom (Northern Ireland).
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

Some commercial categories were targeted by only one country (see Figure 12). Among those, the establishments keeping Anseriformes and Mallards were the most sampled.

	Laying Quails	Ostrichs	Breding Quails	Anser	Mallards	Foie gras Ducks	Fattening Quails	Breeding Anser	Chickens	Quails	Laying Galliform	Foie Gras Geese	Grower Poultry	Breedin Pigeon	Laying Geese	
	Quail (as animal)_Egg production purpose	Ostrich (as animal)_Not Available	Quail (as animal)_Breeding purpose	Anseriformes (as animal)_Mixed purposes	Mallard (as animal)_Not Available	Duck (as animal)_Foie gras production purpose	Quail (as animal)_Meat production purpose	Anseriformes (as animal)_Breeding purpose	Gallus gallus (chicken) (as animal)_Mixed purposes	Quail (as animal)_Mixed purposes	Galliformes (as animal)_Egg production purpose	Goose (as animal)_Foie gras production purpose	Generic poultry (as animal)_Growers	Pigeon (as animal)_Breeding purpose	Goose (as animal)_Egg production purpose	
BG										2	1					3
CZ																0
DE				36												36
DK					21											21
EE																0
ES																0
FI																0
FR						7						1				8
GR													1			1
HR																0
HU		2														2
IS																0
LT																0
LV																0
NO			1					3						1		5
PL	4								3						1	8
PT	1		1				4									6
SE																0
SI		1														1
SK																0
XI																0
	5	3	2	36	21	7	4	3	3	2	1	1	1	1	1	91
	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	

FIGURE 12 Number of Commercial Establishments sampled in 2023 for virology (Part 2/2), presented by RCs and poultry category. The colours indicate the poultry categories with the smallest (lightest blue shade) to the largest (darkest blue shade) number of Establishments sampled. The two grey rows at the bottom report the total number of Establishments sampled for each specific category and the number of countries that targeted it. The counting was performed only for the 27 RCs that adopted the SIGMA-SSD2 standards.
XI: United Kingdom (Northern Ireland).
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

In relation to the zoos, game and non-commercial farming (see Figure 13) the most selected category is represented by the backyards keeping chickens (4 countries, 64 farms) and ducks (3 countries, 12 farms).

	Gallus gallus (chicken) (as animal)_For own consumption	Duck (as animal)_For own consumption	Mallard (as animal)_Game purpose	Pheasant (as animal)_Game purpose	Galliformes (as animal)_Game purpose	Anseriformes (as animal)_Game purpose	Partridge (as animal)_Game purpose	Goose (as animal)_For own consumption	Common Peafowl (as animal)_Zoo animal	Gallus gallus (chicken) (as animal)_Zoo animal	Generic poultry (as animal)_For own consumption	Turkey (as animal)_For own consumption	Peregrine Falcon (as animal)_Game purpose	Canada Goose (as animal)_Zoo animal	Common Merganser (as animal)_Zoo animal	Eastern Imperial Eagle (as animal)_Zoo animal	European Honey-buzzard (as animal)_Zoo animal	Great White Pelican (as animal)_Zoo animal	Jays (as animal)_Zoo animal	
	Backyard Chickens	Backyard Ducks	Game Mallard	Game Pheasant	Game Gallus	Game Anser	Game Partridge	Backyard Geese	Zoo Peafowl	Zoo Chicken	Backyard Poultry	Backyard Turkeys	Game P. falcon	Zoo Geese	Zoo Merganser	Zoo Eagle	Zoo Honey Buzzard	Zoo White Pelican	Zoo Jays	
BG	2	1		2			1													6
CZ						6														6
DE																				0
DK																				0
EE									2	1				1	1	1	1	1	1	9
ES					8	3					5									16
FI			3																	3
FR																				0
GR					12															12
HR																				0
HU																				0
IS																				0
LT																				0
LV																				0
NO	6									1										7
PL	27	2		2				1												32
PT			3	3			3													9
SE			5																	5
SI	29	9						2	1			2								43
SK													2							2
XI																				0
	64	12	11	7	20	9	4	3	3	2	5	2	2	1	1	1	1	1	1	150
	4	3	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	

FIGURE 13 Number of Zoo, Game and NON-Commercial Establishments (Part 1/2) sampled in 2023 for virology, presented by RCs and poultry category. The colours indicate the poultry categories with the smallest (lightest blue shade) to the largest (darkest blue shade) number of Establishments sampled. The two grey rows at the bottom report the total number of Establishments sampled for each specific category and the number of countries that targeted it. The counting was performed only for the 27 RCs that adopted the SIGMA-SSD2 standards.
XI: United Kingdom (Northern Ireland).
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

Estonia and Slovakia performed part of the sampling activity on zoos (see Figure 14).

	Zoo Goshawk	Zoo Hawk-Owl	Zoo Pheasant	Zoo Snowy Owl	Lab Ptarmigan	Zoo Little Egret	Zoo PheasantAllies	Game Buzzard	Zoo Flamingo	Game Golden Eagle	Game N. Goshawk	Game Sparrowhawk	Game Ural Owl	Game West Barn Owl	Backyard pigeons	Bacyard Nandu	
BG																	0
CZ																	0
DE																	0
DK																	0
EE	1	1	1	1													4
ES																	0
FI																	0
FR																	0
GR																	0
HR																	0
HU																	0
IS																	0
LT																	0
LV																	0
NO					1										1		2
PL						1	1										2
PT																	0
SE																	0
SI																1	1
SK								1	1	1	1	1	1	1			7
XI																	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

FIGURE 14 Number of Zoos, Game and NON-Commercial Establishments (Part 2/2) sampled in 2023 for virology, presented by RCs and poultry category. The colours indicate the poultry categories with the smallest (lightest blue shade) to the largest (darkest blue shade) number of Establishments sampled. The two grey rows at the bottom report the total number of Establishments sampled for each specific category and the number of countries that targeted it. The counting was performed only for the 27 RCs that adopted the SIGMA-SSD2 standards.
XI: United Kingdom (Northern Ireland).
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

Figure 15 illustrates the sampling effort across the 27 RCs submitting laboratory data targeting the poultry sector, with no distinction between sampling for serological or virological testing. For 16 countries the number of visits and the number of visited farms (establishments or herds, depending on the level of detail provided) coincide. In two cases, Bulgaria and Romania, the number of visits is considerably higher than the number of visited farms. The data suggest that in these cases the targeted farms were visited more than once. As this is a risk-based type of surveillance, this situation is plausible.

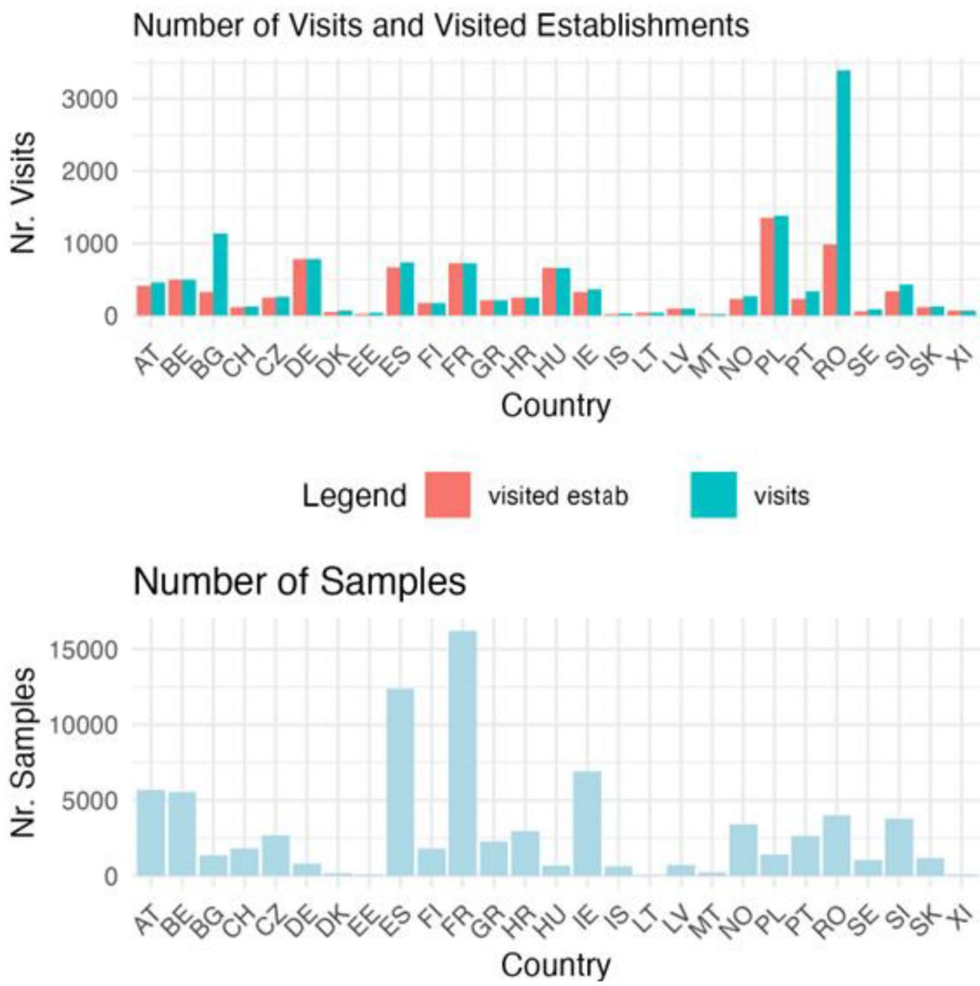

FIGURE 15 ABOVE – number of visits and visited sub-units or establishments (according to the level of detail provided). BELOW – number of samples taken in the poultry. Across the 18 RCs that submitted data following the new SIGMA-SSD2 standards.
XI: United Kingdom (Northern Ireland).
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

3.2.2 | Spatial coverage of poultry sampling activities

In 2023, surveillance activities in poultry were reported for 15 NUTS2 units (Belgium and Italy) and 822 NUTS3 units. Of the 21,183 PEs sampled, 506 were reported at NUTS2 level and 20,677 at NUTS3.

Figure 16 shows the geographical distribution of surveillance activities in 2023. Data are presented at the available NUTS reporting level (i.e. a combination of NUTS2 and NUTS3 units). The sampling density is estimated as the number of PEs sampled per 100 km^2 within a NUTS region.

In 2023, most RCs sampled across most of their NUTS regions, covering the whole European territory as in 2022. France reported sampling activities across all its metropolitan NUTS3, unlike in 2022 when the activities were distributed mainly along the western half of its metropolitan territory.

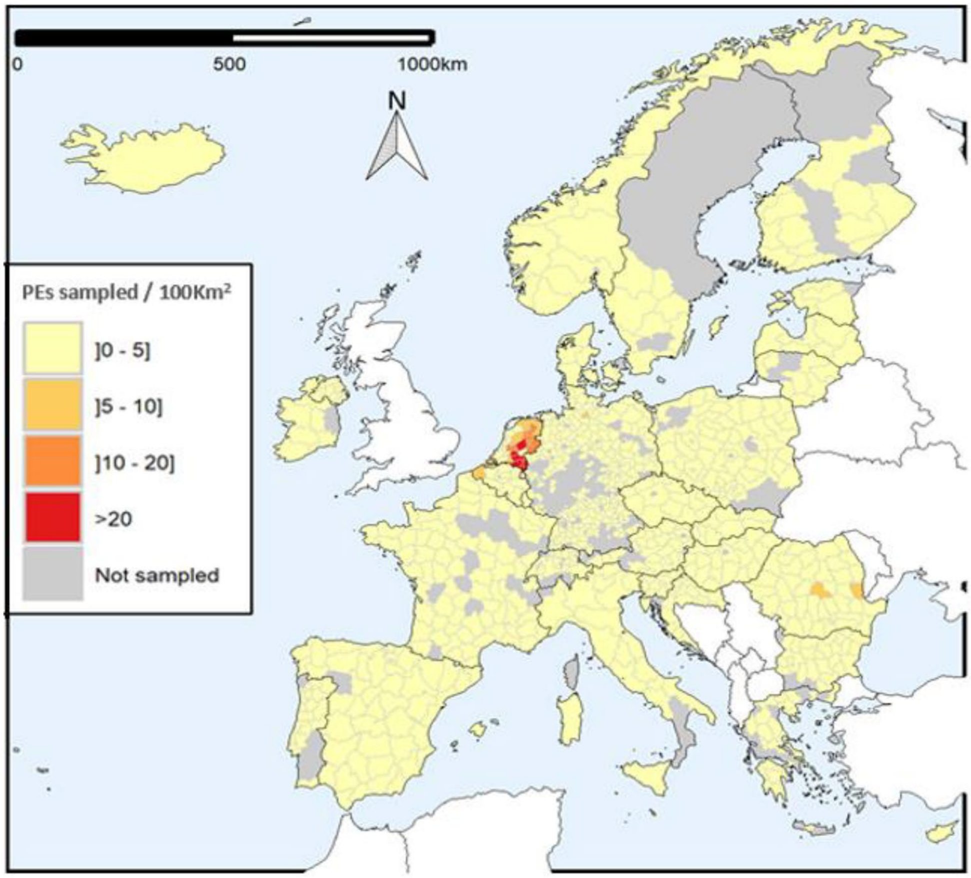

FIGURE 16 Sampling density expressed as the number of PEs sampled for serology and virology per 100 km^2 by administrative unit. Non-reporting countries are shown in white.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland.

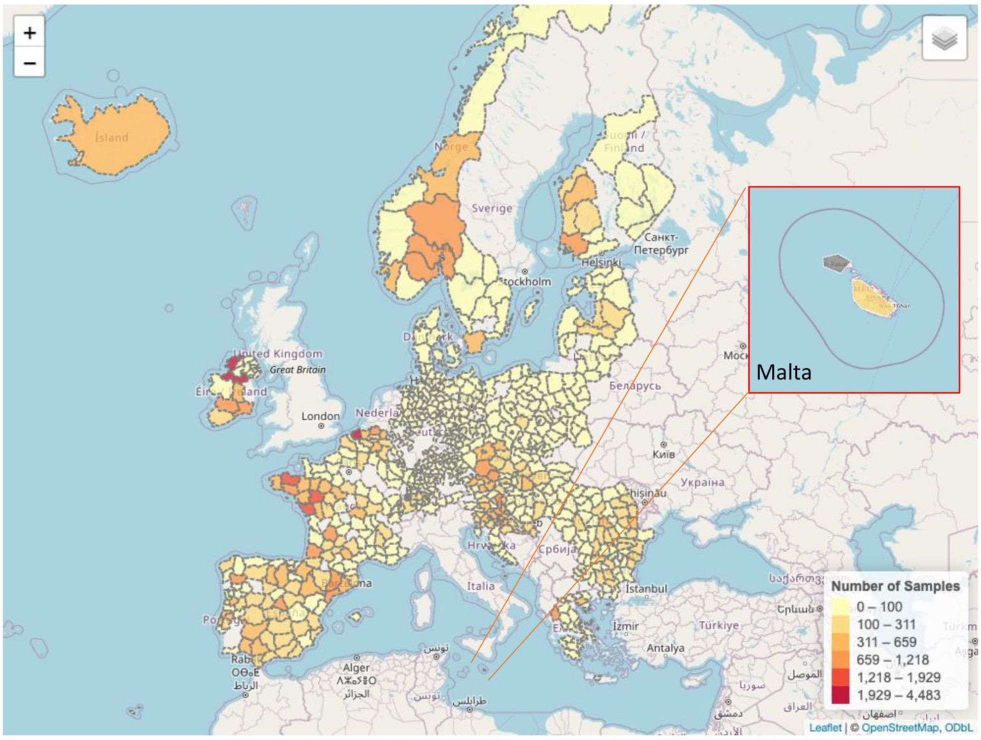

FIGURE 17 Geographical distribution of the samples collected in the poultry sector per NUTS3 region across the 27 RCs that submitted the laboratory data on poultry.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland.

Figure 17 describes the sampling activity from another perspective, reporting the distribution of the number of samples, in the poultry sector, across the 27 RCs that submitted laboratory data on the poultry sector in the new format. The count of the samples has been done at the NUTS level available.

3.2.3 | Temporal coverage of the poultry sampling activities

The bar plot in Figure 18 shows the distribution of the sampling activities over the year. The data used include Active and Passive surveillance, based on the definition given in Section 2.1.3. As it can be seen in, overall, in 2023 the sampling activity was concentrated during the autumn (September–November). The monthly distribution of surveillance activities, however, varied among RCs, as shown in Figure 19.

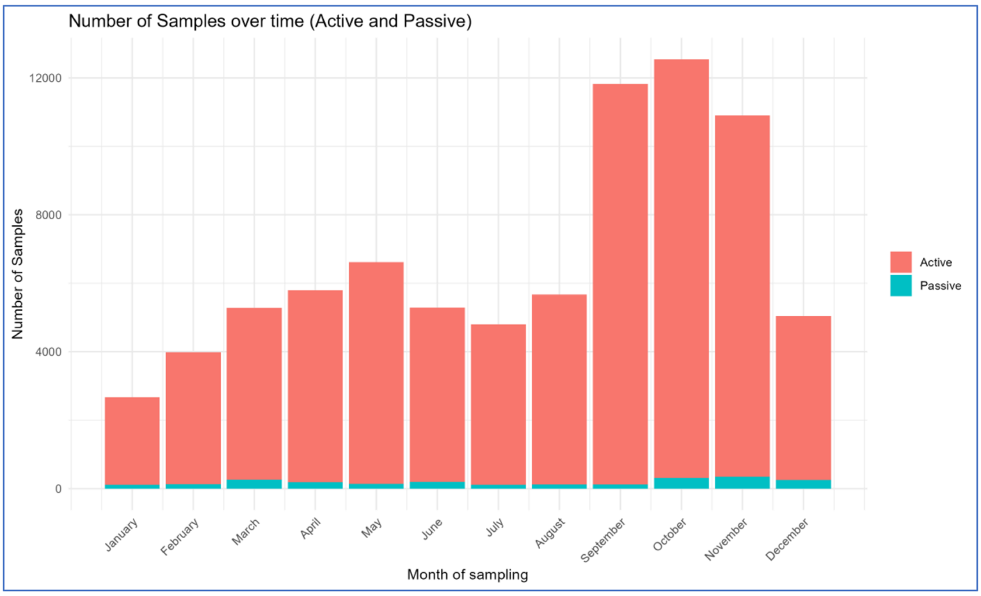

FIGURE 18 Temporal distribution of the samples collected in the poultry sector in 2023 across the 27 RCs that submitted the laboratory data following the new SIGMA-SSD2 standards. Samples taken as Active surveillance and for Passive surveillance are shown.

Most of the RCs conducted sampling activities during both halves of the year (Figure 19). Other countries distributed the sampling activity in a different way, intensifying during the second half (Belgium, France, Hungary, Portugal and United Kingdom (Northern Ireland)) or the first half (Malta). It is interesting to note that some countries opted for executing only samples for virological testing, namely Denmark, Estonia, Hungary, Lithuania and the United Kingdom (Northern Ireland). This is potentially the consequence of different aspects, e.g. (i) the improvement of the virological tests available (providing results in a shorter time) and the decreasing of their cost; (ii) the entry into force of the AHL and related legislation on Avian Influenza, giving more discretion to the countries to decide what diagnostic method to use; (iii) the countries may have focused their surveillance activities on HPAI more than on LPAI.

FIGURE 19 Monthly number of PEs sampled by RCs.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland. and test type in 2023, reflecting heterogeneity in sampling efforts. The scale of the vertical axes varies by country.

The monthly distribution of the serological and virological surveillance activities by poultry category is shown in Figure 20.

Some poultry categories were sampled predominantly for serological testing, i.e. breeding turkeys, free-range laying hens and growers. All other poultry categories, with different proportions and in different periods of the year, were sampled for both, virological and serological testing.

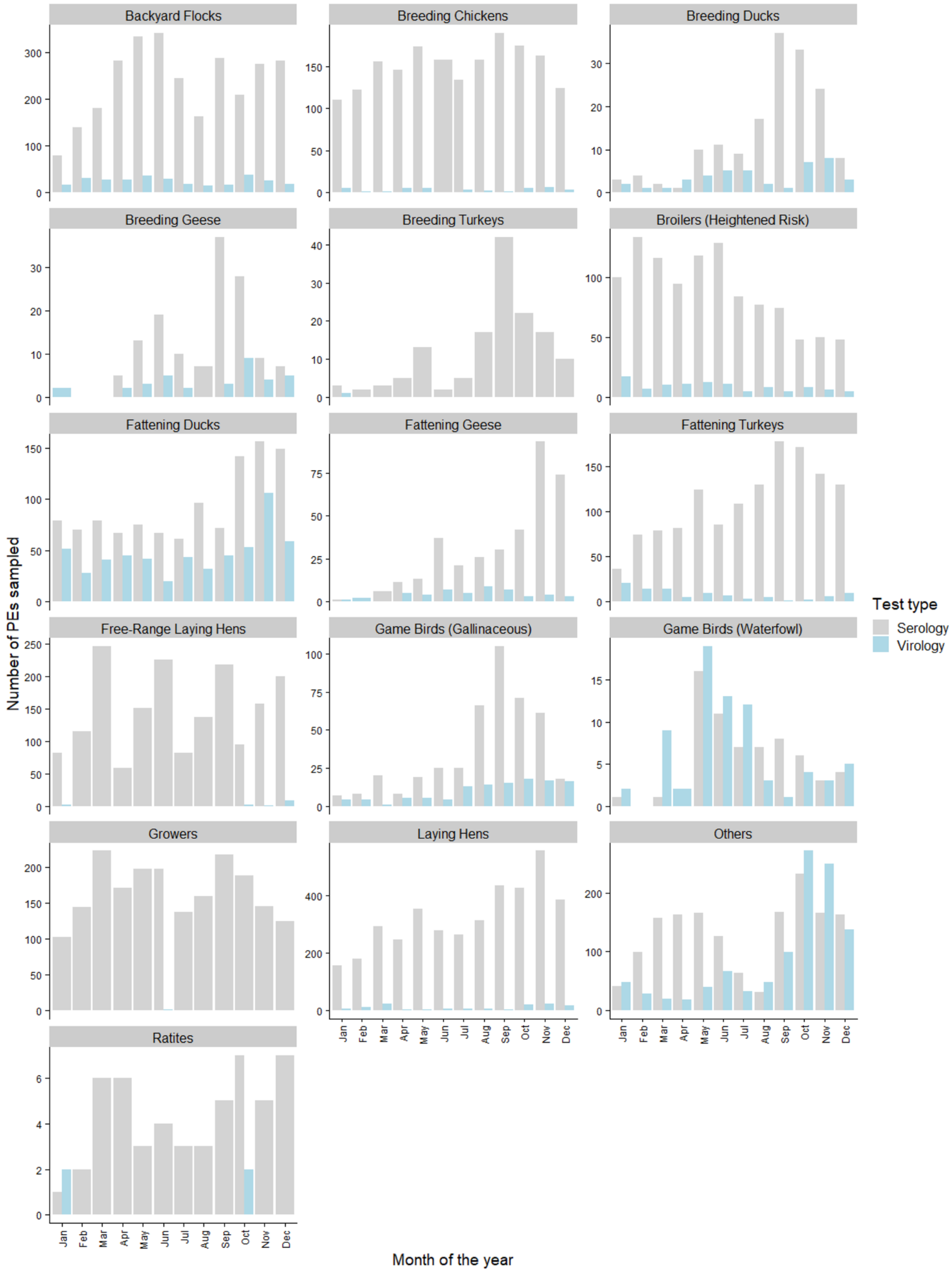

FIGURE 20 Monthly number of PEs sampled by poultry categories and test type in 2023, reflecting heterogeneity in sampling efforts. The scale of the vertical axes varies by poultry categories.

3.3 | Laboratory results from the poultry sector

A summary of the laboratory test results in the poultry sector is presented in Figure 21.

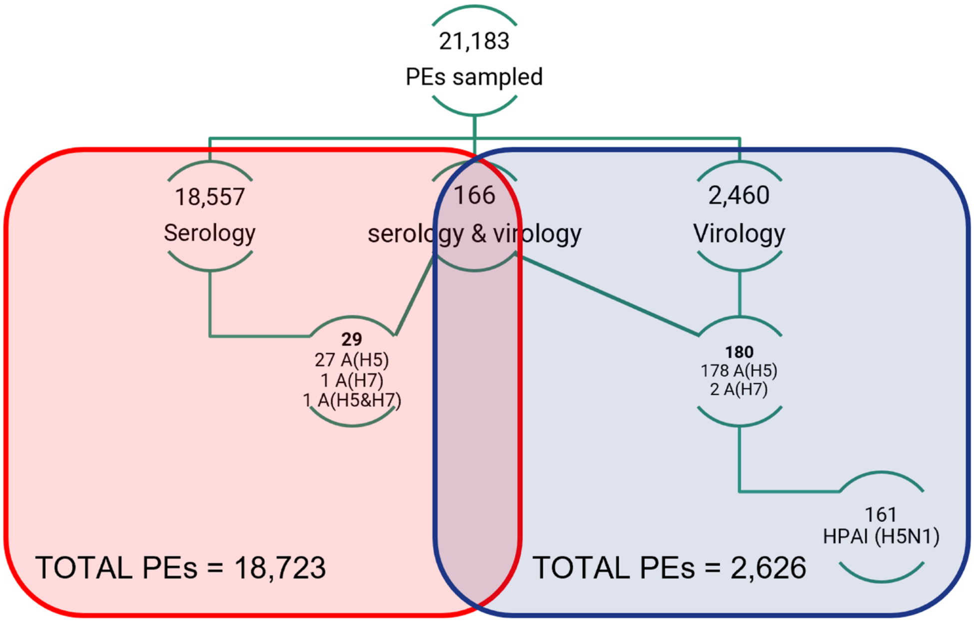

FIGURE 21 Overview of the laboratory results in the poultry sector. The red square pertains to the results obtained from the serological testing of 18,723 PEs; the blue square pertains to the results obtained from the virological testing of 2626 PEs.

3.3.1 | Serological survey results

In previous reports, interpretations of temporal trends were based on the assumption that sampling strategies and targeting remained constant in all RCs throughout the years. With the introduction of virological surveys by the Commission Delegated Regulation (EU) 2020/689, which took effect in April 2021 (Figure 20), this assumption can be challenged; therefore, interpretations before and after the implementation will be limited (Figure 22).

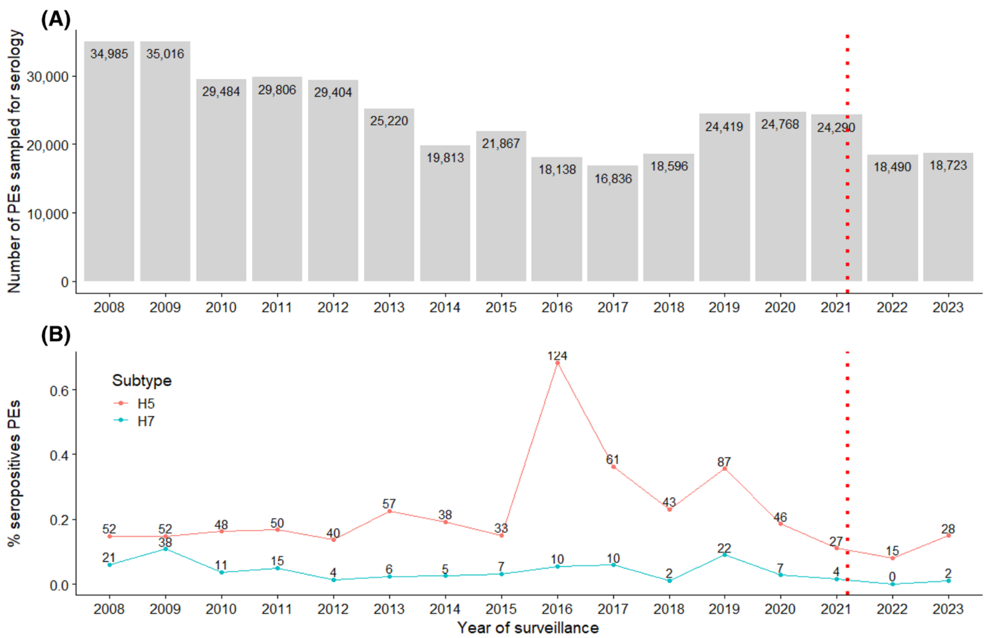

FIGURE 22 (A) Total number of PEs sampled for serology per year and (B) the line graph of the percentage of the PEs seropositive for A(H5/H7) viruses, with the number of seropositive PEs shown per year as labels. In 2023, a PE was seropositive for A(H5) and A(H7) and counted in each label. The red vertical line represents the change in surveillance strategies based on the Commission Delegated Regulation (EU) 2020/689, which took effect in April 2021.

In 2023, the total number of PEs sampled and tested **by serology** was 18,723. This number was slightly higher than in 2022 (Figure 20A) but lower than the 3 years before the Commission Delegated Regulation (EU) 2020/689 was implemented. Twenty-seven PEs were **seropositive** for influenza A(H5) viruses in 2023 (see also Figure 23). The percentage of A(H5) seropositive PEs was 0.15%, which is also greater than that of the previous year (0.08%). Also, one of the PEs sampled tested positive for influenza A(H7) (see also Figure 23) when no A(H7)-seropositive PEs were identified in 2022. One PE was seropositive to both A(H5) and A(H7), which means that a **total of 29 PEs were seropositive to A(H5/H7)** by serological survey in 2023.

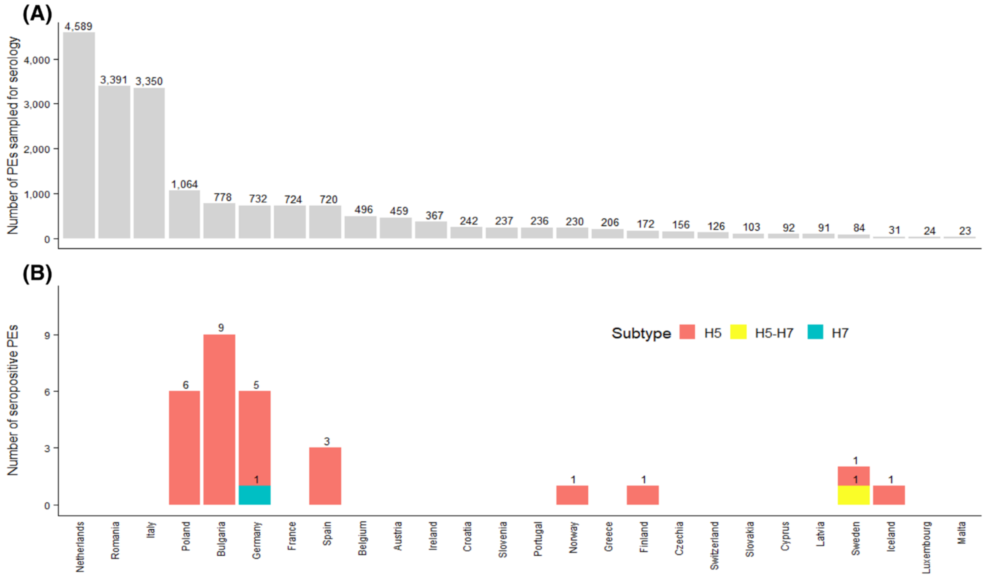

FIGURE 23 (A) Total number of PEs sampled for serology in 2023 shown per RC in descending order and (B) total number of seropositive PEs found by subtype.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland.

As per previous years, considerable variation in the number of PEs sampled was observed among RCs in 2023 (Figure 23). Three countries (the Netherlands, Romania and Italy) accounted for 60.5% of all PEs sampled by serological assay in 2023, like the results in 2022 (64.7%). The total number of PEs sampled ranged from 23 in Malta to 4589 in the Netherlands, with the median number of PEs sampled in RCs being 236.5. Eight countries (Poland, Bulgaria, Germany, Spain, Norway, Finland and Sweden) reported **A(H5)-seropositive** PEs ($n = 26$). Germany reported one **A(H7)-seropositive** PE and Sweden one PE **seropositive to both A(H5) and A(H7)**. The Icelandic A(H5)-seropositive resulted from an imported bird kept in quarantine and cannot, therefore, be considered as a positive case.

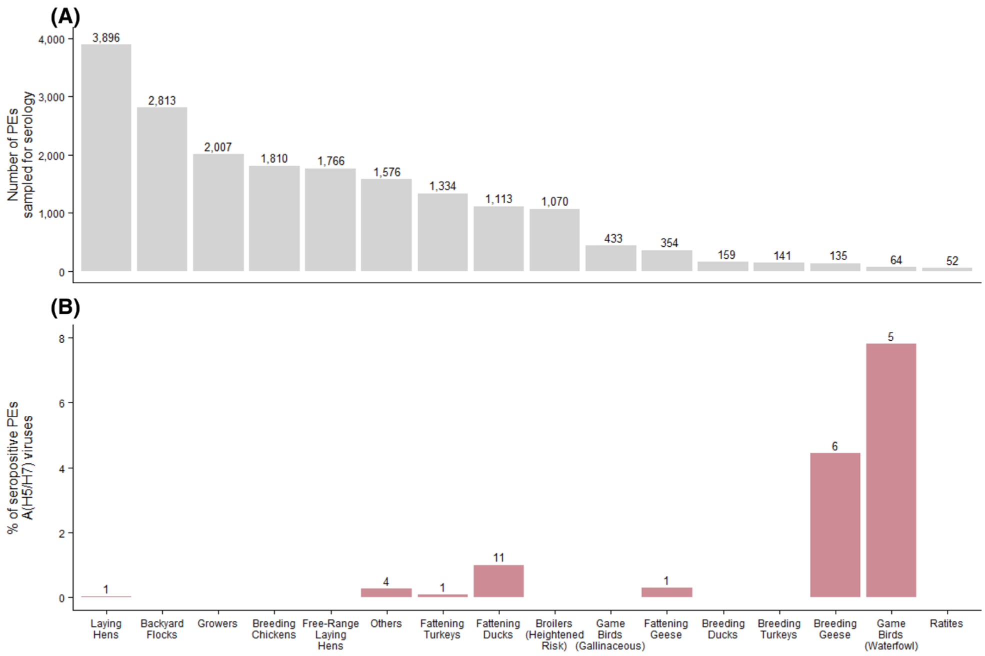

FIGURE 24 (A) Total number of PEs sampled for serology by poultry category with values above bars referring to the number of PEs sampled, (B) percentage (*y*-axis) and number (above bars) of PEs sampled that tested seropositive for influenza A(H5/H7) viruses by poultry category.

As in 2022, the highest numbers of PEs sampled by RCs in 2023 belonged to conventional laying hen and backyard categories ($n = 3896$ and $n = 2813$, respectively) (Figure 24A). The order of the most frequently sampled categories to the least is very similar to the previous year (changes limited to four categories). Other categories sampled in large numbers ($n > 1500$) were growers, breeding chickens, free-range laying hens and others.

In 2023, as in 2022, the highest percentage of A(H5/H7)-seropositive PEs was found in the waterfowl game bird (7.8% out of 64 PEs sampled), followed by the breeding geese (4.4% out of 135 PEs sampled). Proportions of seropositive PEs were below 1% for all other poultry categories, including fattening ducks (1% out of 1113 PEs sampled). Laying hens is the only other poultry category where A(H5/H7)-seropositive PEs were found in 2022; all other categories with A(H5)-seropositive PEs in 2023 did not have any in 2022 (Fattening turkeys, fattening geese and others).

In addition to A(H5/H7) seropositive survey results, 10 RCs reported seropositive PEs for **non-A(H5/H7) subtype AIVs** (Austria, Belgium, Bulgaria, Germany, Latvia, Luxembourg, the Netherlands, Norway, Spain and Sweden). There were 152 PEs seropositive to non-A(H5/H7) subtype AIVs; the poultry categories that contributed the most being the 'others' category, backyard flocks, laying hens and fattening turkeys ($n > 10$). Proportions of PEs seropositive for non-A(H5/H7) subtype AIVs by poultry category may not be reliably estimated, as reporting of these subtypes is non-mandatory. Therefore, results for non-A(H5/H7) subtype AIVs are excluded from Figure 14.

3.3.2 | Summary of the serological results

Figure 25 shows only the RCs and poultry categories in which A(H5/H7)-seropositive PEs were detected. Bulgaria, Germany and Poland were the countries reporting the most A(H5/H7)-positive PEs. These PEs belonged mainly to fattening ducks (Bulgaria and Germany), breeding geese (Poland) and 'others' categories (Germany).

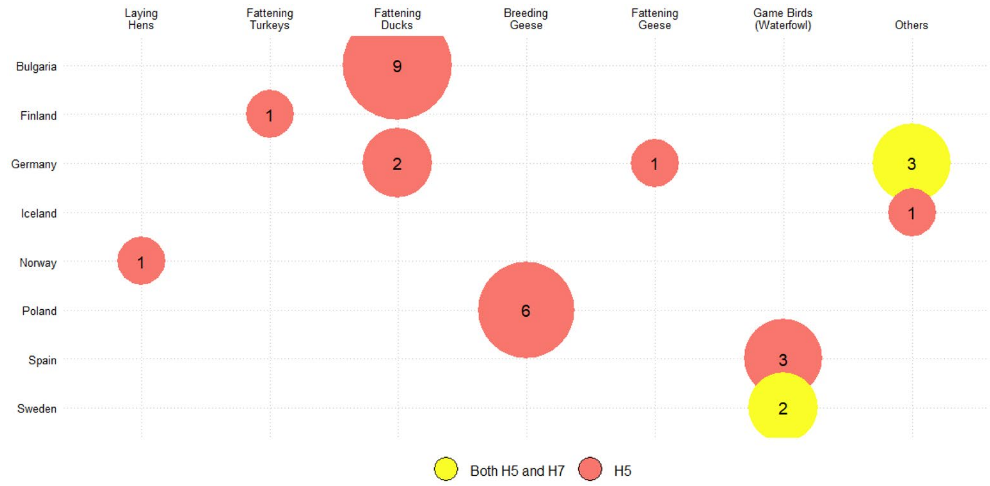

FIGURE 25 Total number of PEs seropositive for influenza A(H5/H7) viruses by RC and poultry category in 2023.

3.3.3 | Virological survey results from serological positive PEs

Out of the 29 PEs with positive serological tests for influenza A(H5/H7) viruses, samples from 13 PEs were also tested for AIV viral RNA using PCR, which resulted in four of these PEs testing also positive by PCR; all of unknown pathogenicity:

- two positive PEs for unknown subtype (but non-H5/H7) in waterfowl game birds in Sweden,
- one positive PE for the A(H1N2) subtype in waterfowl game birds in Spain confirmed by virus isolation,
- six of the seropositive PEs were tested by PCR on the same day, while the remainder were re-sampled for PCR testing on average 6 days after the serological tests. In addition, three PEs were negative to the serology but positive to PCR:
- two positive PE for unknown subtypes in waterfowl game birds in Finland.

16 PEs with positive serological tests for influenza A(H5/H7) viruses were not further investigated with virological tests.

3.3.4 | Overall virological survey results

As in the previous section, comparisons of incidence rates between different groups relate **to the sampled populations only**. They cannot be extrapolated to the source populations because:

- sampling targeted higher-risk groups (non-representative sampling strategy) in some RCs;
- the definition and prioritisation of higher-risk groups may differ between RCs, between groups and between years.

The percentages provided in this report relate to the surveillance samples submitted for virological testing only. The underlying population cannot be used as a denominator. Interpretations of temporal trends are not available as this is the first year this surveillance activity is described in detail.

In 2023, 178 PEs sampled for virological survey were positive for influenza A(H5) viruses and 2 PEs for influenza A(H7) viruses. Overall, 6.85% of PEs were A(H5/H7)-positive. The percentage of A(H5) positive PEs was 6.78% with a total number of PEs sampled taken for virology of 2626, while the percentage of A(H7) positive PEs was 0.08%.

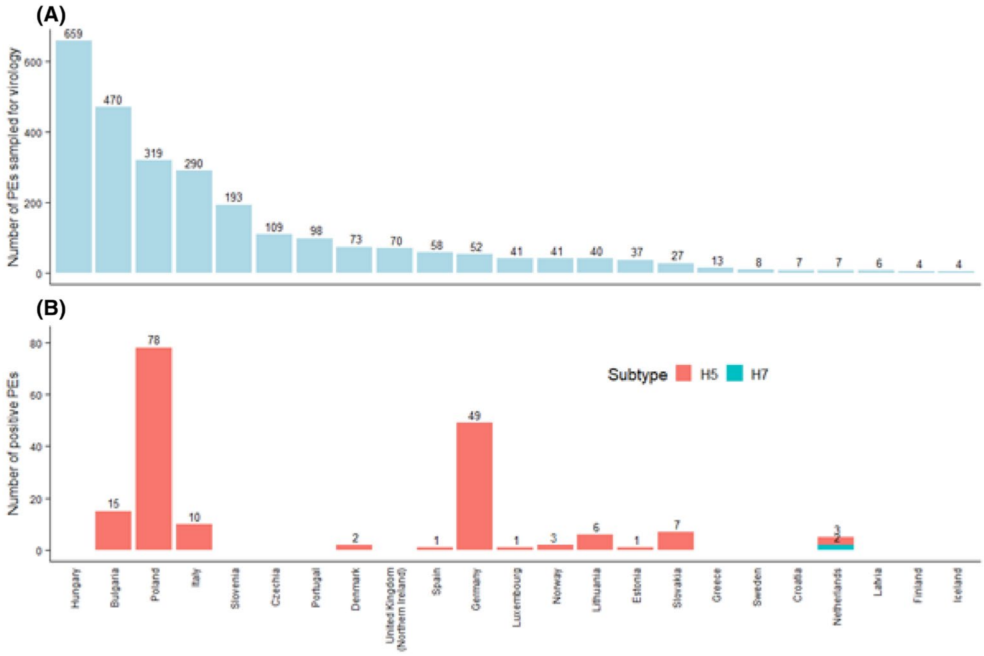

FIGURE 26 (A) Total number of PEs sampled for virology in 2023 shown per RC in descending order and (B) the total number of positive PEs found by subtype.

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Protocol on Ireland/Northern Ireland, the EU requirements on data sampling also apply to Northern Ireland.

Considerable variation in the number of PEs sampled was observed among the 24 RCs who reported sampling taken for virological surveys in 2023 (Figure 26). Four countries (Hungary, Bulgaria, Poland and Italy) accounted for 66.2% of all PEs sampled by virological surveys in 2023. The total number of PEs sampled ranged from 4 in Iceland or Finland to 659 in Hungary, with the median number of PEs sampled in RCs being 41 (Figure 26A). Twelve countries reported A(H5/H7)-positive PEs ($n=178$ PEs) from the virological survey. One RC, the Netherlands, also reported A(H7)-positive PEs. With 79 A(H5)-positive PEs, Poland has the highest number of positive samples. At the same time, Hungary, Slovenia, Czechia, Portugal, the United Kingdom (Northern Ireland), Greece, Sweden, Latvia, Finland and Iceland had no positive PEs sampled.

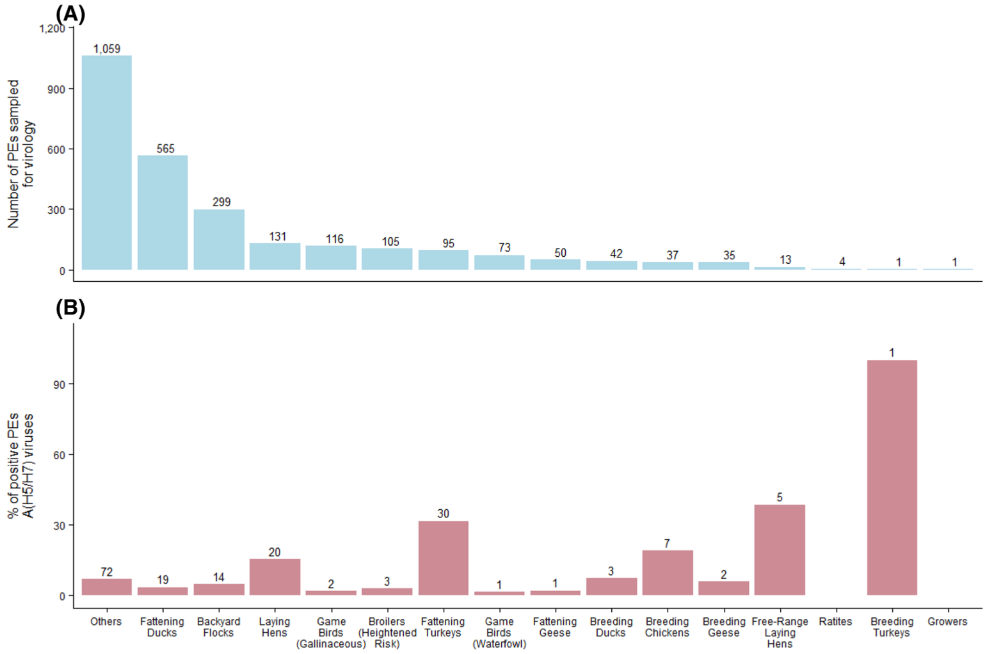

FIGURE 27 (A) Total number of PEs sampled for virology by poultry category with values above bars referring to the number of PEs sampled, (B) percentage (y-axis) and number (above bars) of PEs sampled that tested positive for influenza A(H5/H7) viruses by poultry category.

The highest numbers of PEs sampled by RCs in 2023 were from the others and fattening ducks categories ($n = 1059$ and $n = 565$, respectively) (Figure 27A). Other categories sampled in large numbers ($n > 100$) were backyard flocks, laying hens, game birds (gallinaceous) and broilers (heightened risk). This observation is different from the previous year and should be interpreted in light of the previous note regarding classifications. Not all information in 2023 was available to correctly classify all PEs in the appropriate poultry category, which could explain the high percentage of the 'others' category being sampled this year. In 2023, the highest percentage of A(H5/H7)-positive PEs sample for virological survey varied between 1.4% (waterfowl game bird) and 100% (breeding turkeys) of PEs in each poultry category and a median at 5.2%. All poultry categories had A(H5/H7)-positive PEs sampled except for ratites and growers, who were only sampled less than five times.

3.3.5 | Summary of the virological test results

Figure 28 shows an overview of the number of AIV-positive PEs by RC and poultry category through virological testing in 2023. Of all RCs, 17 countries reported detection of AIVs in 14 different poultry categories. Of these countries, 13 reported AIVs in a maximum of two different poultry categories. However, Germany, Poland, Bulgaria and Italy reported positive cases in eight, eight, four and three categories, respectively. Out of 180 A(H5/H7)-positive PEs reported 161 PEs were HPAI A(H5N1) virus, however:

- Bulgaria reported untyped HPAI(H5) in three laying hen PEs, one breeding duck PE and one fattening duck PE;
- The Netherlands reported in free-range laying hens one LPAI A(H7N3) PEs, one untyped LPAI A(H5) positive PE, as well as two A(H5) PE and A(H7) PE, both N-untyped and of unknown pathogenicity;
- Slovakia reported 7 A(H5N1)-positive PEs of unknown pathogenicity in the 'others' poultry categories.
- Denmark reported one LPAI A(H5N1) positive PE in waterfowl game birds;
- Luxembourg reported A(H5N1) positive PE of unknown pathogenicity in a backyard flock.

Also, as described in the previous section, four of the following PEs (two in Sweden, one in Spain and one in Iceland) were also seropositive and three of them (two in Finland and one in Spain) were seronegative. All four seropositive PEs also appeared in all figures in the paragraphs describing the serological results. Furthermore, the non-A(H5/H7) PCR-positive PE from Czechia is from a single positive screening PCR test among 40 different reported tests (20 screening and 20 confirmation), requiring prudence on the interpretation of this result.

FIGURE 28 Number of PEs positive for influenza A viruses by RC and poultry category resulting from virological testing in 2023.

The sensitivity of virological surveillance activities to detect HPAIV in RCs depends on several parameters, including the size of the poultry population, the distinct PEs sampled, the sensitivity of within-establishment sampling and the design prevalence (the proportion of distinct PEs that is expected to be infected should HPAI be present in the country).

Eleven RCs reported positive test results for non-A(H5/H7) subtypes AIVs[14] in poultry (Bulgaria, Denmark, Estonia, Lithuania, Czechia, Finland, Germany, Iceland, Portugal, Spain and Sweden) as shown in Figure 28. There were 58 PEs positive to non-A(H5/H7) subtype AIVs from breeding ducks, fattening ducks, game birds (waterfowl) and *others*. Proportions of PEs seropositive for non-A(H5/H7) subtype AIVs by poultry category may not be reliably estimated, as reporting of these subtypes is non-mandatory. However, more specifically among those results, additional information was available:

- 38 non-LPAI(H5/H7) PEs all in the 'others' category of establishment, with 34 in Lithuania and 4 in Iceland;
- 15 non-LPAI(H5/H7) across multiple countries (Bulgaria, Sweden, Denmark, Finland, Czechia, Estonia and Germany) and poultry categories (game birds (waterfowl), *others*, fattening ducks and breeding ducks);
- One A(H1N2)-positive game bird waterfowl PE in Spain;
- One A(H11N9)-positive breeding duck PE and one A(H6N1)-positive breeding duck PE in Germany;
- One A(H12N6)-positive game bird waterfowl PE in Portugal.

4 | WILD BIRDS

For the correct interpretation of the results presented in this section, please note that wild birds 'found dead' or 'alive with clinical signs' (including injured wild birds) were classified under **passive surveillance**.

In contrast, wild birds reported as 'hunted with clinical signs,' 'hunted without clinical signs' and 'alive without clinical signs' were considered as wild birds sampled by **active surveillance**.

This is consistent with the classification method followed in previous reports.

4.1 | Wild bird population

Voluntary contribution data on the abundance and distribution of wild bird species have been made available to EFSA by the EuroBirdPortal (EBP). EBP[15] is one of the three major monitoring projects run by the European Bird Census Council (EBCC). This project mobilises year-round observational data submitted by volunteer birdwatchers to the online wild bird recording portals operating across Europe (about 50 million wild bird records from about 100,000 voluntary contributors annually). Information on the distribution of the 50 species included in the target list of wild bird species is being submitted to EFSA annually, aggregated at NUTS3 and monthly levels. Please note that in this map the target species refers to the

[14]Reporting of non-A(H5/H7) subtype AIVs by MSs is non-mandatory.

[15]https://eurobirdportal.org/ebp/en/#home/HIRRUS/r52weeks/CUCCAN/r52weeks/.

original list and not to the one recently published by EFSA. The data provide two different measures for each NUTS3 region and month:

- the total number of all wild birds observed in that specific location during that month,
- the number of wild birds for each of the 50 species included in the target list of wild bird species observed in that location during that month.

The total number of wild birds observed is a function of abundance and observation effort. This value may be used as an indirect measure of the effort taking place in a given location. However, it may not be directly interpreted as the observation effort, as this would assume constant abundance across locations.

Figure 29 shows the density of all wild birds (upper map) and wild birds of the 50 target species (lower map) observed in a specific location, each estimated as the total number of observations in the NUTS3 region divided by the surface of the area (also available in Zenodo).[16] This figure shows that the countries with the most regions with densities of observations of wild birds higher than 5000 per km (all species, i.e. an indirect measure of the observation effort) are Austria, Belgium, Switzerland, Germany, Denmark, Greece, Estonia, France, Italy, the Netherlands, Poland, Portugal and the United Kingdom. No data were provided by Lithuania and Malta. Within countries, the variability between NUTS3 regions was high. During the year, wild bird observations were reported at least once for 1438 NUTS3 regions in total in the countries for which EBP data were available. Wild birds from the EFSA target list were reported in all these NUTS3 regions except for rare sporadic NUTS3 like in Croatia or Belgium (Figure 40, lower map).

Showing these two types of records, observation effort and density for a given species provides an indicator of the reliability of the data presented. For example, if a low number of wild birds of the species included in the list of target species is observed for a certain NUTS3 region and month, in an area where the observation effort is high (many total observations), our confidence in the reliability of the information would be higher than if the total number of observations was low.

Additional maps are available in Zenodo[17] at the monthly level: these maps display both the number of wild birds from target species observed in each NUTS3 region (EBP data) and the number of wild birds from target species sampled by passive surveillance (RCs data).

[16] https://zenodo.org/uploads/14515393.
[17] https://zenodo.org/uploads/14515393.

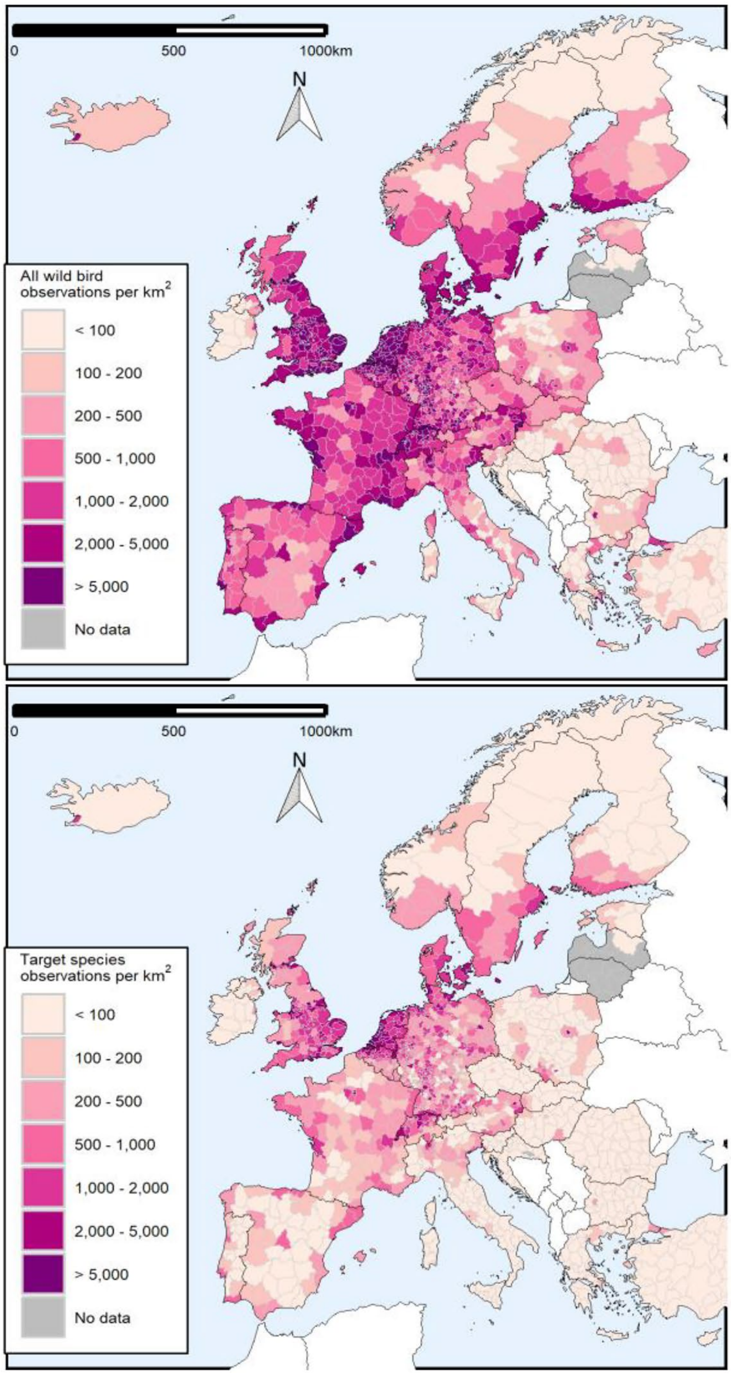

FIGURE 29 Density of wild bird observations for 2023 by NUTS3 region, as per data provided by the EBP project. The density of observations was estimated as the total number of observations in the NUTS3 region divided by the surface of the area. The upper map shows all wild bird species, while the lower map is restricted to species from the EFSA target list (before 2024).

4.2 | Sampling wild birds

4.2.1 | Overview of the sampling activity in wild birds

For this report, wild birds 'found dead' or 'alive with clinical signs' (including injured wild birds) were classified under **passive surveillance**. In contrast, wild birds reported as 'hunted with clinical signs', 'hunted without clinical signs' and 'alive without clinical signs' were considered as wild birds sampled by **active surveillance**. This is consistent with the classification method followed in previous reports. Active surveillance is assumed to be undertaken by voluntary contributors as MSs may choose, depending on their risk analysis, not to target those populations except for wild birds 'hunted with clinical signs'.

In 2023, in relation to wild birds, the sampling activity mainly targeted live birds with clinical signs and found dead, i.e. passive surveillance (33,244 samples – 75% of the total number of samples). Nonetheless, the active surveillance, targeting live birds without clinical signs, and hunted birds (with and without clinical signs) is not negligible (8212 samples – 25% of the total number of samples). Table 5 illustrates the number of **samples** (single and pooled) collected by the 28 RCs that submitted the data in the new format.

TABLE 5 Number of samples on wild and captive birds per country. Counting performed on the data submitted by the 27 RCs that followed the new SIGMA-SSD2 standards.

Country	Number wild birds samples	Country	Number wild birds samples
Austria	942	**Ireland**	424
Belgium	764	**Latvia**	393
Bulgaria	89	**Lithuania**	197
Croatia	53	**Malta**	59
Cyprus	218	**Norway**	935
Czechia	142	**Poland**	567
Denmark	404	**Portugal**	114
Estonia	106	**Romania**	365
Finland	1053	**Slovakia**	52
France	4263	**Slovenia**	1113
Germany	8632	**Spain**	6723
Greece	84	**Sweden**	760
Hungary	593	**Switzerland**	484
Iceland	70	**United Kingdom (Northern Ireland)**	68

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

In terms of number of **animals sampled**, the 27 MSs, Iceland, Norway, Switzerland and the United Kingdom (Northern Ireland) (31 RCs) sampled 50,897 **wild birds**, either by active or passive surveillance. MSs are not obliged to report surveillance results from activities other than the EU co-funded surveillance activities. Nonetheless, in addition to the sampling carried out under European funding ('EU co-funded passive surveillance,' in Figure 30), six MSs reported surveillance results from their national programmes (non-EU co-funded programmes) (Belgium, Germany, Hungary, Poland, Romania and Spain). Iceland, Norway and Switzerland reported results from their national programmes. Poland also reported surveillance activities under private programmes. Five countries did not provide any information about the funding source (Croatia, Denmark, Malta, Slovenia and the United Kingdom (Northern Ireland)).

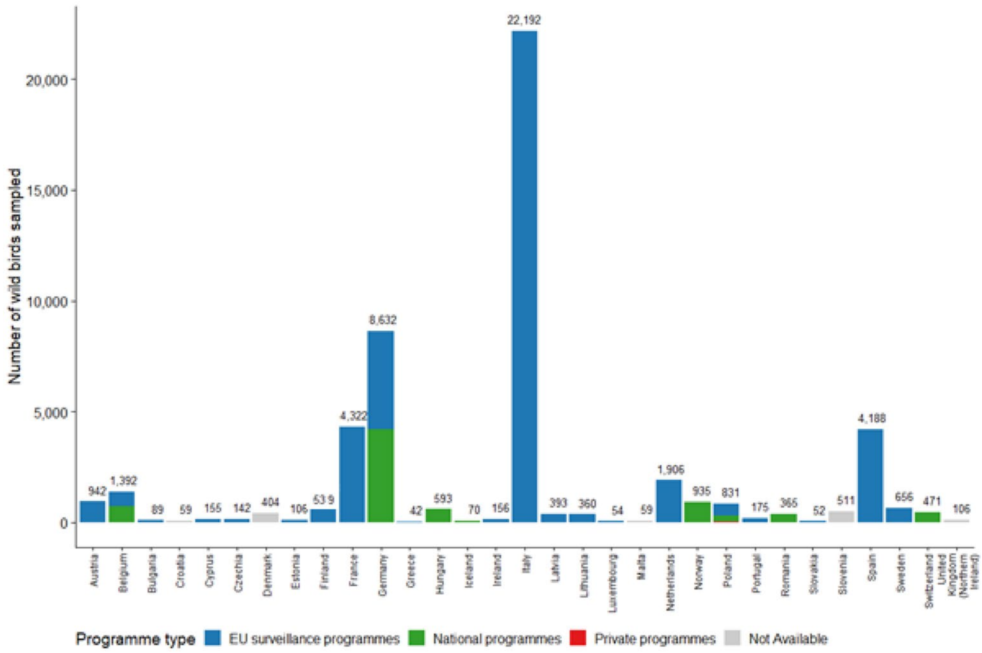

FIGURE 30 Number of wild and captive birds sampled by RCs in 2023 according to the type of surveillance programme.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

All 31 RCs reported results from their passive surveillance programmes in 2023. Of the total number of **wild birds** sampled, 33,629 were sampled by passive surveillance, marking an increase of more than 50% compared to the previous year (*n* = 22,099 in 2022), already greater than the past 4 prior years (Table 6). This increase is mainly due to Italy, which sampled 12,286 wild birds by passive surveillance and 9906 wild birds by active surveillance (the total number of wild bird samples in Italy in 2023 (*n* = 22,192) is slightly greater than the number of wild birds sampled by passive surveillance in the whole of Europe in 2022 (*n* = 22,099)). The sensitivity of passive surveillance for AI in wild birds depends highly on the probability of contributors discovering and reporting wild birds found dead, injured or with clinical signs.

Some RCs (*n* = 15) also reported results from active surveillance. Belgium and Norway sampled more wild birds by active than passive surveillance, and Germany, Italy and Spain sampled more than 1000 wild birds by active surveillance. Although active surveillance was carried out in other countries, the data shown in this report represents only the data submitted to EFSA. As reporting from all active surveillance in wild birds to EFSA is non-mandatory, the numbers reported below do not represent the full extent of active surveillance activities conducted by some countries. Consequently, this report contains complete data for passive surveillance only and focuses mainly on summarising the sampling activities and results obtained by passive surveillance.

TABLE 6 Number of wild and captive birds sampled by RCs in 2023 (light grey background), with active and passive surveillance presented separately and combined as a total, and the number of wild birds sampled by passive surveillance from 2018 to 2022 (no background colour). In case of small numbers or no data reported for active surveillance, the respective RC may have reported only little data to EFSA or not carried out active surveillance.

Reporting country	Passive surveillance						Active surveillance			Total		
	2018	2019	2020	2021	2022	2023	2021	2022	2023	2021	2022	2023
Austria	109	85	183	419	338	942	0	0	0	419	338	942
Belgium	237	423	275	290	944	675	448	1499	717	738	2443	1392
Bulgaria	58	65	70	103	54	73	13	4	16	116	58	89
Croatia	223	160	92	110	70	58	0	0	1	110	70	59
Cyprus	109	87	137	129	183	146	7	14	9	136	197	155
Czechia	94	104	127	208	51	142	0	0	0	208	51	142
Denmark	148	111	288	760	432	404	0	0	0	760	432	404
Estonia	16	8	3	307	62	104	12	44	2	319	106	106
Finland	195	174	222	560	360	539	0	0	0	560	360	539
France	113	158	503	875	3098	4322	0	3	0	875	3101	4322
Germany	1711	1392	3041	7321	4600	4365	7844	5336	4267	15,165	9936	8632
Greece	13	12	6	26	64	39	4	10	3	30	74	42
Hungary	371	338	472	228	639	593	0	0	0	228	639	593
Iceland		2	9	18	159	70	0	0	0	18	159	70
Ireland	142	78	165	265	202	156	0	0	0	265	202	156
Italy	2109	2719	2791	4005	3652	12,286	0	0	9906	4005	3652	22,192
Latvia	14	15	4	151	57	393	0	0	0	151	57	393
Lithuania	70	63	139	234	156	360	0	0	0	234	156	360
Luxembourg		50	135	305	62	54	0	0	0	305	62	54
Malta			9	9	47	59	42	39	0	51	86	59
Netherlands	663	643	878	1149	1540	1906	0	0	0	1149	1540	1906
Norway		28	128	348	491	407	800	533	528	1148	1024	935
Poland	36	33	97	649	263	521	777	390	310	1426	653	831
Portugal	82	126	74	64	182	174	0	40	1	64	222	175
Romania	244	201	107	213	224	347	19	7	18	232	231	365
Slovakia	84	45	83	82	31	52	0	0	0	82	31	52
Slovenia	178	231	270	323	308	455	0	0	56	323	308	511
Spain	344	281	437	732	2995	2758	490	2125	1430	1222	5120	4188
Sweden	455	456	410	803	610	656	0	0	0	803	610	656
Switzerland	45	30	55	162	114	467	6	0	4	168	114	471
United Kingdom	1282	816	1208									
United Kingdom (Northern Ireland)				72	111	106	0	0	0	72	111	106
Total	**9145**	**8934**	**12,418**	**20,920**	**22,099**	**33,629**	**10,462**	**10,044**	**17,268**	**31,382**	**32,143**	**50,897**

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

4.2.2 | Spatial coverage of the sampling in wild birds

Figure 31 illustrates the distribution of the samples collected, aggregated at NUTS3 level.

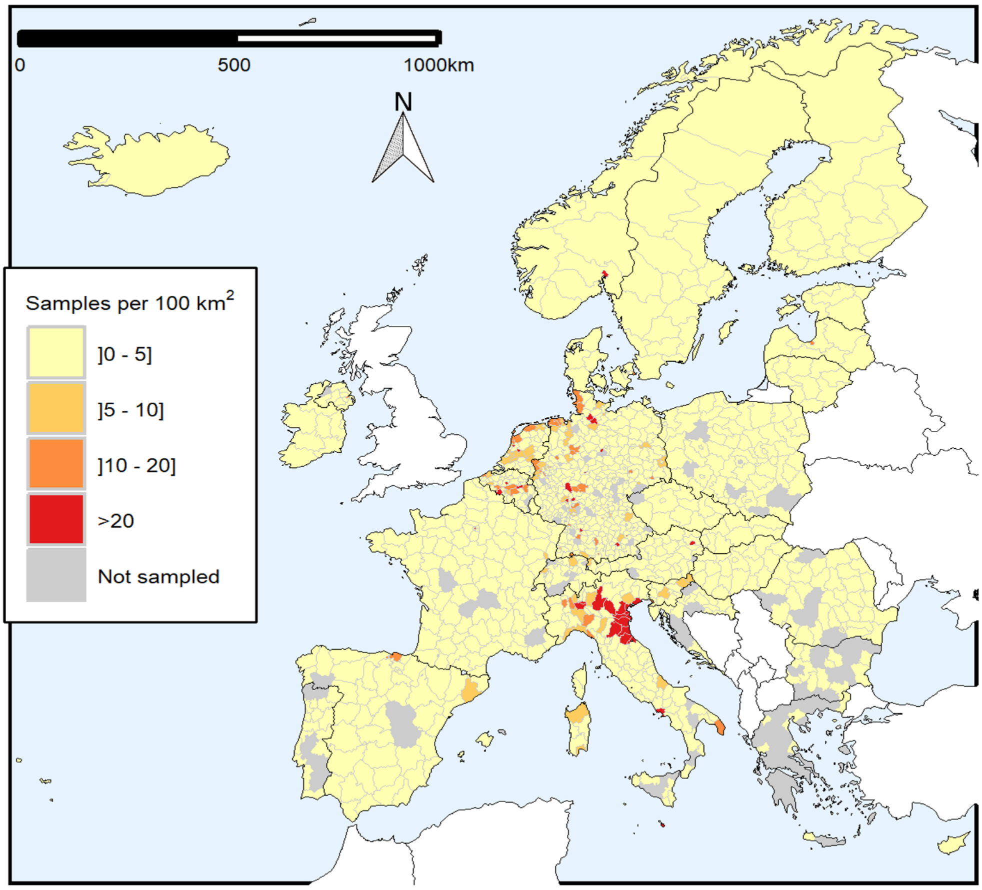

FIGURE 31 Sampling density, expressed as the numbers of wild birds sampled per 100 km^2.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

All RCs included location coordinates with wild bird sampling results. Figure 31 shows the geographical distribution of surveillance activities in wild birds conducted by RCs in 2023. Data are aggregated at the NUTS3 level. Most of the RCs' territories are covered by surveillance activities. As of 2022, the strong efforts in Belgium, the Netherlands and Germany along the North Sea persist. However, in 2023, Italy increased wild bird sampling, specifically in its north-east regions (Lombardy, Veneto and Emilia-Romagna). Furthermore, areas on the eastern border of Europe that were not sampled in 2022 were almost all sampled in 2023 except in the south.

4.2.3 | Temporal coverage of the sampling in wild birds

Figure 32 shows the quarterly distribution of the number of wild birds sampled by passive surveillance In 2023 for each RC. The highest numbers of samples were taken during the first quarter (January–March). The distribution of sampling across the quarter was lower but relatively consistent across all remaining three quarters:

- quarter 1: 10,473 wild birds, (31%)
- quarter 2: 9098 wild birds, (27%)
- quarter 3: 8198 wild birds, (24%)
- quarter 4: 6374 wild birds, (19%)

Figure 32 highlights variation among RCs regarding the sampling distribution throughout the year (percentage of samples taken during each quarter by each RC).

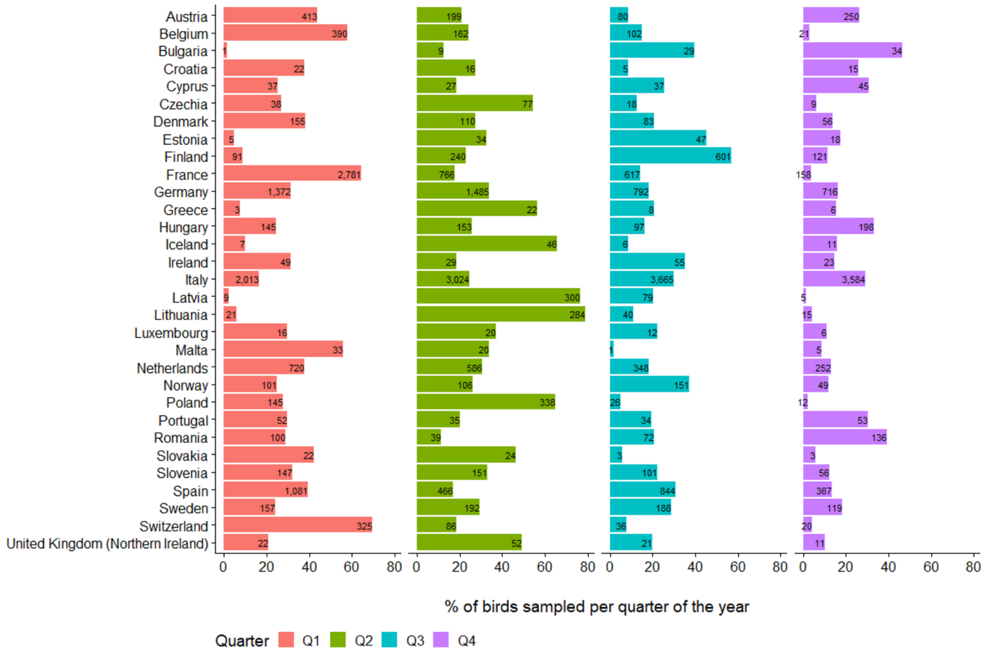

FIGURE 32 Quarterly percentage (bars) and total numbers (values) of wild and captive birds sampled by passive surveillance by RCs in 2023, with the first quarter starting in January 2023.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

4.2.4 | Number of birds sampled per order

Among wild birds sampled by both passive and active surveillance, the most frequently sampled order was Anseriformes ($n = 18{,}701$), historically the most sampled order. The second most sampled order is represented by Charadriformes ($n = 11{,}016$). The orders Passeriformes, Columbiformes and Accipitriformes were also sampled in high numbers ($n > 1500$ each) as in 2022 (Figure 33).

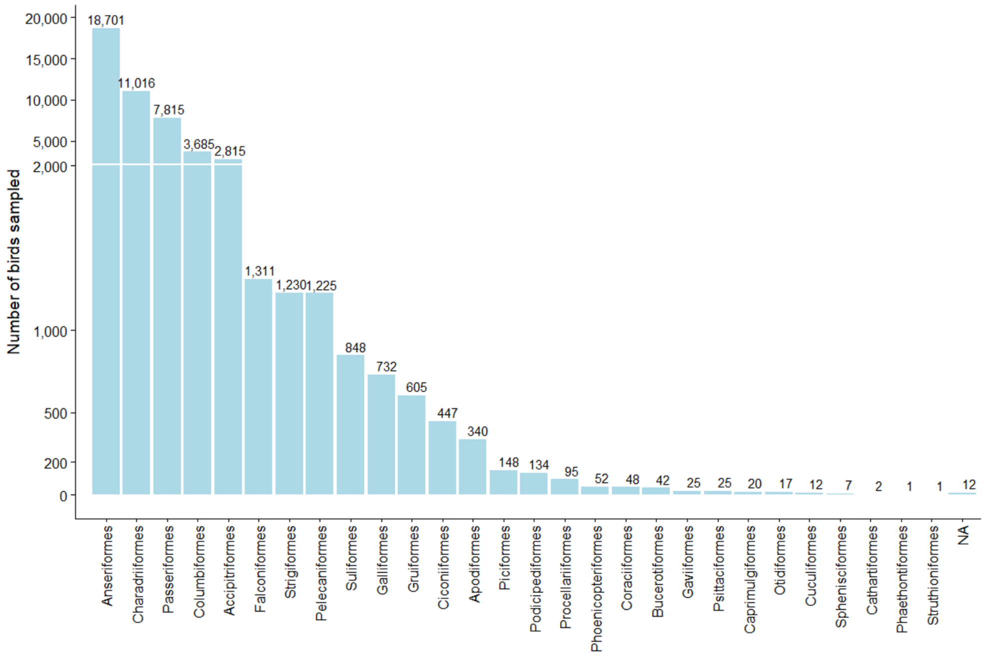

FIGURE 33 Total numbers of wild birds of the different orders sampled by passive and active surveillance by RCs in 2023. The y-axis is presented on an interrupted scale to improve visibility.

4.3 | Laboratory results on wild birds

A summary of the laboratory results in wild birds is presented in Figure 34.

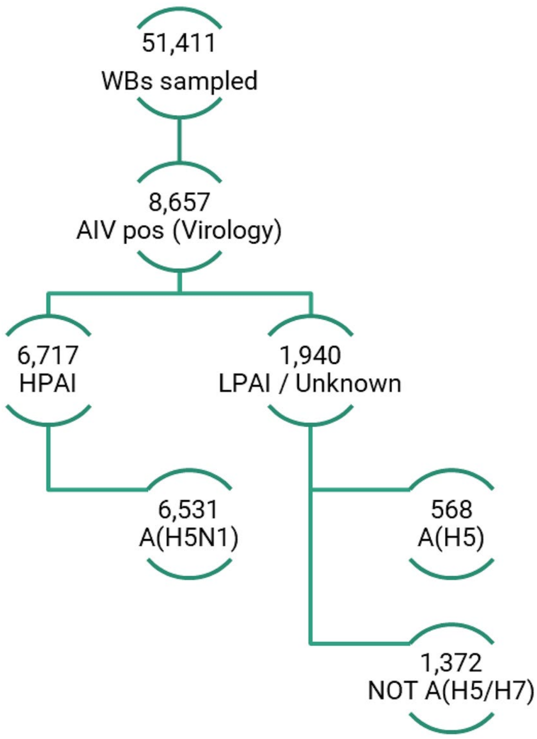

FIGURE 34 Overview of the laboratory results in wild birds.

4.3.1 | Wild birds – detection of AIV in samples

Combining both active and passive surveillance, a total of 8657 (16.8%) wild birds, out of the 51,411 sampled by RCs, tested positive for avian influenza viruses (AIVs) as detailed in Table 7. This percentage is marginally higher than that recorded in 2022 (16%), which itself was significantly elevated compared to previous years (9.9% in 2021, 8.6% in 2020 and 4.7% in 2019). The marked increase in sampling effort, coupled with the high proportion of infected birds, likely reflects the elevated infection pressure among wild birds in 2023, as described in EFSA reports (EFSA, Aznar, et al., 2023).

Of the 8657 AIV-positive wild birds, 6717 (77.6%) were infected with HPAIVs and 1940 (22.4%) with LPAIVs. In 2023, passive surveillance identified 94.6% of the total AIV-positive wild birds, maintaining a similar detection level as in preceding years. Most of these birds were 'found dead' (8010 birds tested AIV-positive, including 6523 positives for HPAIVs). The proportions of HPAIV-positive wild birds in active and passive surveillance were 2.7% and 23.9%, respectively.

The efficacy of the surveillance type varies according to the virus pathogenicity. When focusing on LPAI viruses, active surveillance proves more effective, recording 87.3% LPAI-positive cases compared to the 18.7% detected by passive surveillance (Figure 35).

TABLE 7 Test results for wild birds sampled by passive (no background colour) and active (light grey background) surveillance by RCs in 2023, presented by wild bird status.

	Wild bird status	No. of wild birds sampled	No. of AIV-positive wild birds		
	Bird status		**Positive by PCR or VI**	**HPAIV**	**LPAIV**
Active	Hunted without clinical signs	2041	141 (7%)	11	130
	Live without clinical signs	15,135	330 (2.2%)	49	281
	Subtotal	**17,176**	**471 (2.7%)**	**60**	**411**
Passive	Found dead	32,756	8010 (24.4%)	6523	1487
	Live with clinical signs	1387	136 (9.8%)	103	33
	Subtotal	**34,235**	**8186 (23.9%)**	**6657**	**1529**
Total		**51,411**	**8657 (16.8%)**	**6717**	**1940**

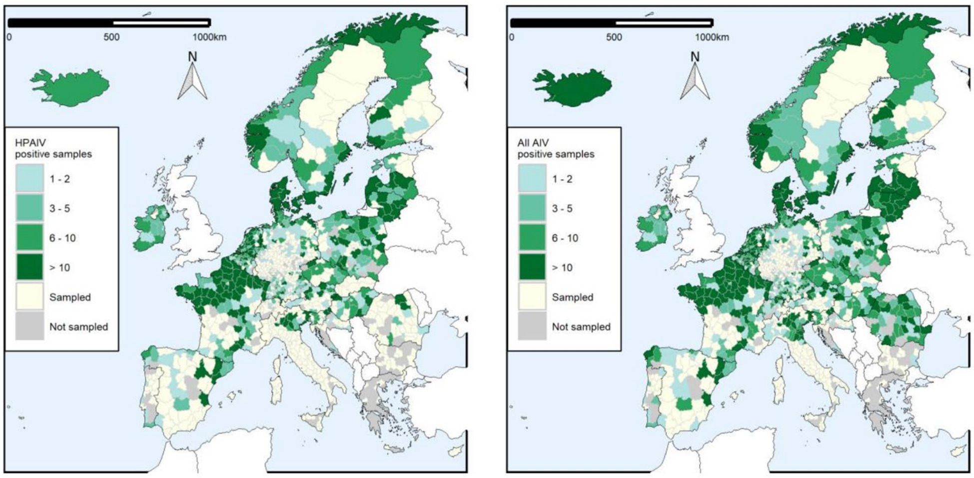

FIGURE 35 Geographical distribution of all AIV-positive wild birds (left) and HPAIV-positive wild birds (right) by administrative unit. Non-reporting countries are shown in white.
In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

4.3.2 | Highly pathogenic AIV in wild birds

Table 8 shows the proportion of HPAIV-positive wild birds by type of surveillance. The highest percentages of HPAIV-positive wild birds by passive surveillance were found in Lithuania (57.5% of samples), followed by France (55% of samples), Czechia (45.1%) and Denmark (42.8%).

TABLE 8 Total numbers of wild and captive birds sampled and positive for HPAIVs by passive and active surveillance in each RC. Cells with a grey background indicate that no HPAIV-positive wild birds were detected in the respective RC by the respective surveillance activity.

	Passive surveillance		Active surveillance	
Country	**No. of wild birds**	**No. of HPAIV-positive wild birds(%)**	**No. of wild birds**	**No. of HPAIV-positive wild birds(%)**
Austria	942	219 (23.2%)	0	–
Belgium	675	253 (37.5%)	717	0 (0%)
Bulgaria	73	0 (0%)	16	0 (0%)
Croatia	58	8 (13.8%)	1	0 (0%)
Cyprus	146	0 (0%)	9	0 (0%)
Czechia	**142**	**64 (45.1%)**	0	–
Denmark	**404**	**173 (42.8%)**	0	–
Estonia	104	11 (10.6%)	2	0 (0%)

TABLE 8 (Continued)

Country	Passive surveillance		Active surveillance	
	No. of wild birds	No. of HPAIV-positive wild birds(%)	No. of wild birds	No. of HPAIV-positive wild birds(%)
Finland	539	77 (14.3%)	0	–
France	**4322**	**2377 (55%)**	0	–
Germany	4365	994 (22.8%)	4267	65 (1.5%)
Greece	39	0 (0%)	3	0 (0%)
Hungary	593	85 (14.3%)	0	–
Iceland	70	9 (12.9%)	0	–
Ireland	156	37 (23.7%)	0	–
Italy	12,286	260 (2.1%)	9906	25 (0.3%)
Latvia	393	70 (17.8%)	0	–
Lithuania	**360**	**207 (57.5%)**	0	–
Luxembourg	54	0 (0%)	0	–
Malta	59	0 (0%)	0	–
Netherlands	1906	731 (38.4%)	0	–
Norway	407	102 (25.1%)	528	1 (0.2%)
Poland	521	395 (75.8%)	310	0 (0%)
Portugal	174	6 (3.4%)	1	0 (0%)
Romania	347	87 (25.1%)	18	0 (0%)
Slovakia	52	0 (0%)	0	–
Slovenia	455	104 (22.9%)	56	0 (0%)
Spain	2758	143 (5.2%)	1430	0 (0%)
Sweden	656	135 (20.6%)	0	–
Switzerland	467	7 (1.5%)	4	0 (0%)
United Kingdom (Northern Ireland)	106	48 (45.3%)	0	–

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

Figure 36 displays the timeline of HPAIV detection in wild birds in RCs in 2023 for passive and active surveillance separately (blue and red, respectively). As part of the continuing HPAI A(H5Nx) epidemic since late 2020, HPAIV-positive wild birds were detected in the first week of 2023. However, unlike in 2022, between weeks 30 and 44, the detection of HPAIV-positive wild birds fell under 7% despite strong sampling efforts. Two main waves in the proportion of HPAIV-positive wild birds in passive surveillance can be observed: one in the fifth week, when 51.8% of the sampled wild birds were HPAIV-positive and the other one in the 19th week, when 32.8% of the sampled wild birds were HPAIV-positive. The end of the year (weeks 44 to 53) is characterised by a slow increase in the percentage of HPAIV-positive in sampled wild birds. However, the proportion observed in the last week of the year peaked at 11.2%, which is much lower than the observed peak during the year and lower than the percentage observed in the last week of 2022 (above 20%).

The pattern observed is different from the continuous presence of the HPAIV-positive birds all year long that occurred in 2022 but is also different from previous years with a shorter and later (summer) break in 2023 compared to 2021. Furthermore, the proportion of wild bird orders among the weekly HPAIV-positive wild birds varied throughout the year. Between weeks 1 and 13, the HPAIV-positive wild birds most frequently order belong to the Charadriiformes, with Anseriformes the second most frequent order. Between weeks 14 and 32 (spring period), the HPAIV-positive wild birds mainly belong to the Charadriiformes with the other wild bird orders never above 15 HPAIV-positive wild birds per week. Between weeks 44 and 52 (autumn period), Anseriformes or Gruiformes are the most frequent order with HPAIV-positive samples, which is closer to the patterns observed in 2021 and 2020.

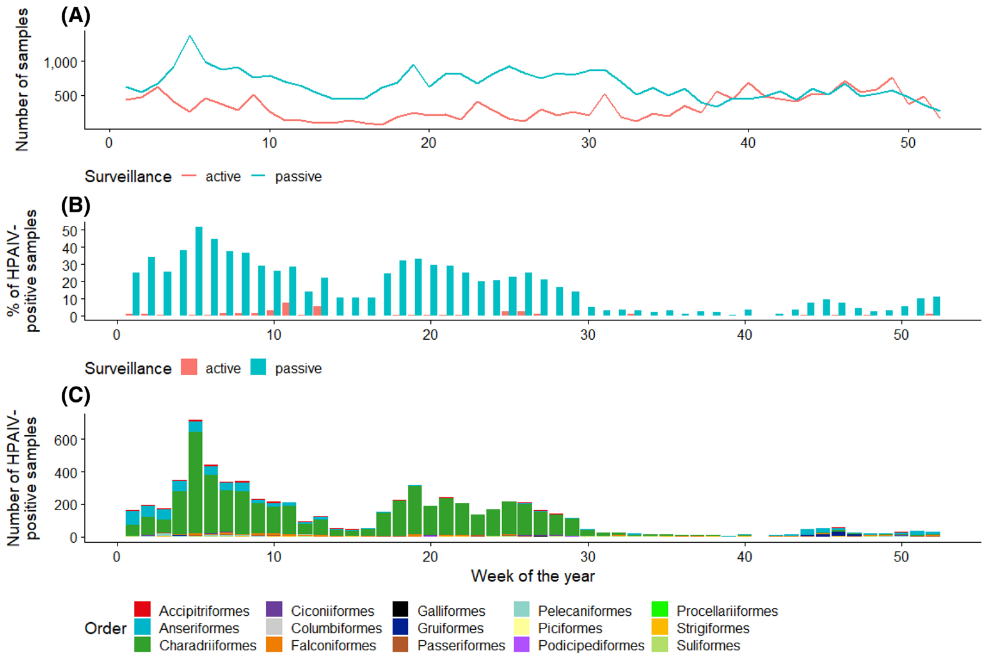

FIGURE 36 (A) Weekly number of wild birds sampled by both passive and active surveillance, (B) weekly percentage of HPAIV-positive wild birds found and (C) weekly number of HPAIV-positive wild birds by taxonomic order.

4.3.3 | Low pathogenic AIV in wild birds

Among the 1940 wild birds that tested positive for AIVs other than HPAIVs, 565 wild birds were infected with LPAIVs, while no virus pathogenicity results were available for the remaining 1375 wild birds. Out of the 1375 wild birds for which information on the virus pathogenicity was unavailable, there were 501 wild birds positive for A (H5) viruses. For the remainder of this section, 'LPAIV-positive' wild birds include all positive wild birds which were not positive for HPAIVs ($n = 1940$). This is consistent with previous reports.

LPAIV-positive wild birds were reported by 24 RCs and mainly from passive surveillance activities (78.4%). Among all LPAIV-positive wild birds, 568 were classified as A(H5) and none as A(H7) viruses. The majority of the LPAIVs detected were reported as non-A(H5/H7) subtype AIVs ($n = 1310$), without further information on the subtypes provided.

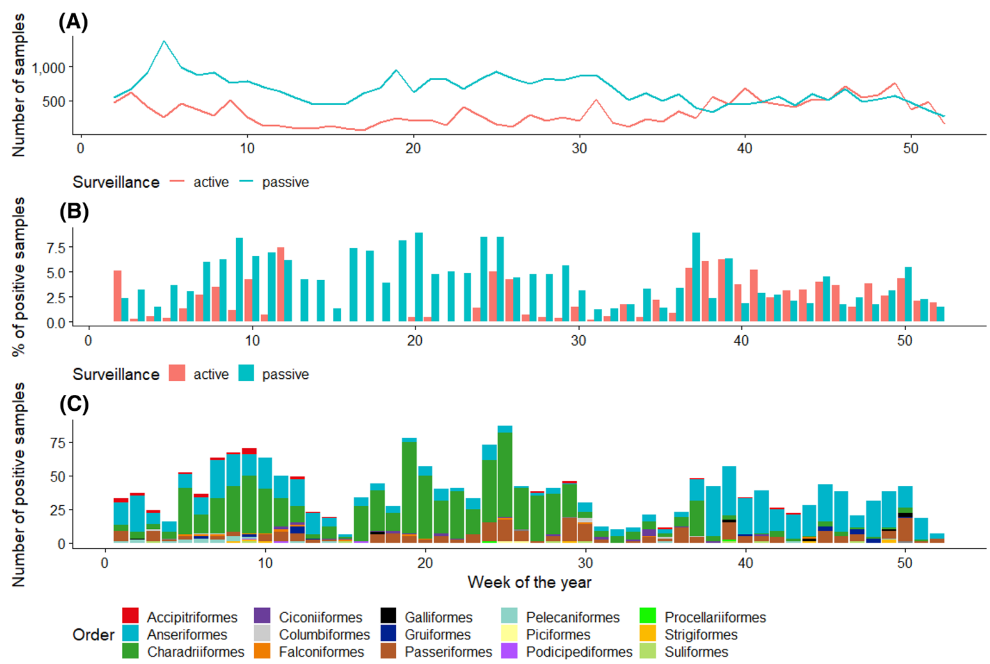

FIGURE 37 (A) Weekly number of wild birds sampled by both passive and active surveillance, (B) weekly percentage of LPAIV-positive wild birds found and (C) weekly number of LPAIV-positive wild birds by taxonomic order.

As shown in Figure 37, the highest percentage of LPAIV-positive wild birds was found in week 37 ($n=7.9\%$) for passive surveillance and in week 12 ($n=37.4\%$) for active surveillance. However, as for HPAIV-positive wild birds and unlike in previous years, no distinct seasonal pattern can be observed. Also, as in the previous section on HPAIV-positive wild birds, most LPAIV-positive wild birds belonged to the order Charadriiformes until autumn, when most frequent LPAIV-positive wild birds belonged to the Anseriformes order (Figure 37C). The pattern similarity could be due to a misclassification of HPAIV-positive into wild birds into LPAIV-positive because the pathogenicity of the samples was not always reported by RCs.

5 | ADIS DATA

With the aim of creating a comprehensive report where all relevant information on avian influenza can be found, in this section the outbreaks of HPAIVs submitted through the Animal Disease Information System (ADIS) are reported.

5.1 | HPAI virus detections in birds in Europe

In 2023, in the poultry sector (see Table 9), a total of 507 outbreaks were reported by the 19 affected EU countries (Austria, Belgium, Bulgaria, Croatia, Czechia, Denmark, Estonia, France, Germany, Hungary, Italy, Lithuania, Netherlands, Poland, Romania, Slovakia, Slovenia, Spain, Sweden), and 16 from the three affected non-EU countries (Kosovo[18], Moldova and Switzerland).

TABLE 9 [ADIS data] Number of outbreaks in the poultry sector reported by EU countries and non-EU countries in 2023.

	EU	Non-EU
Number of countries affected	19	3
Number of outbreaks	507	16
Number of losses	9,673,921	786

In relation to wild or captive birds, the outbreaks were significantly higher (see Table 10).

Twenty-three EU countries reported 3379 outbreaks, namely, Austria, Belgium, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden.

Seven non-EU countries reported 277 outbreaks: Iceland, Moldova, Norway, Serbia, Switzerland, Ukraine, United Kingdom.

TABLE 10 [ADIS data] Number of outbreaks in wild birds reported by EU countries and non-EU countries in 2023.

	EU	Non-EU
Number of countries affected	23	7
Number of outbreaks	3379	277

The geographical distribution of the outbreaks can be seen in Figure 38 regarding the poultry sector, where the outbreak size was estimated considering the number of animals potentially present in the affected establishment, as reported in the 'Susceptible' field in ADIS data. In Figure 39, the geographical distribution of the outbreaks can be seen in relation to the wild and captive birds.

The two maps taken together reveal a substantial overlapping of the findings and related outbreaks, particularly in the European northern coasts.

[18]Kosovo – this designation is without prejudice to positions on status and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo Declaration of Independence.

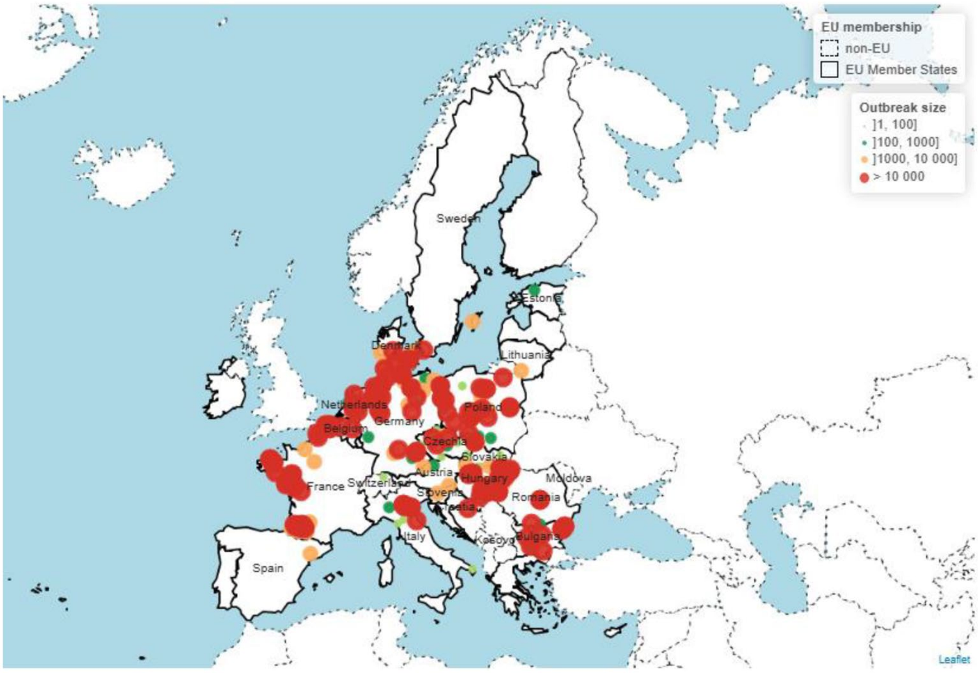

FIGURE 38 [ADIS data] Location and size of the outbreaks in the poultry sector in 2023 as reported in ADIS by the RCs.
Kosovo – this designation is without prejudice to positions on status and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo Declaration of Independence

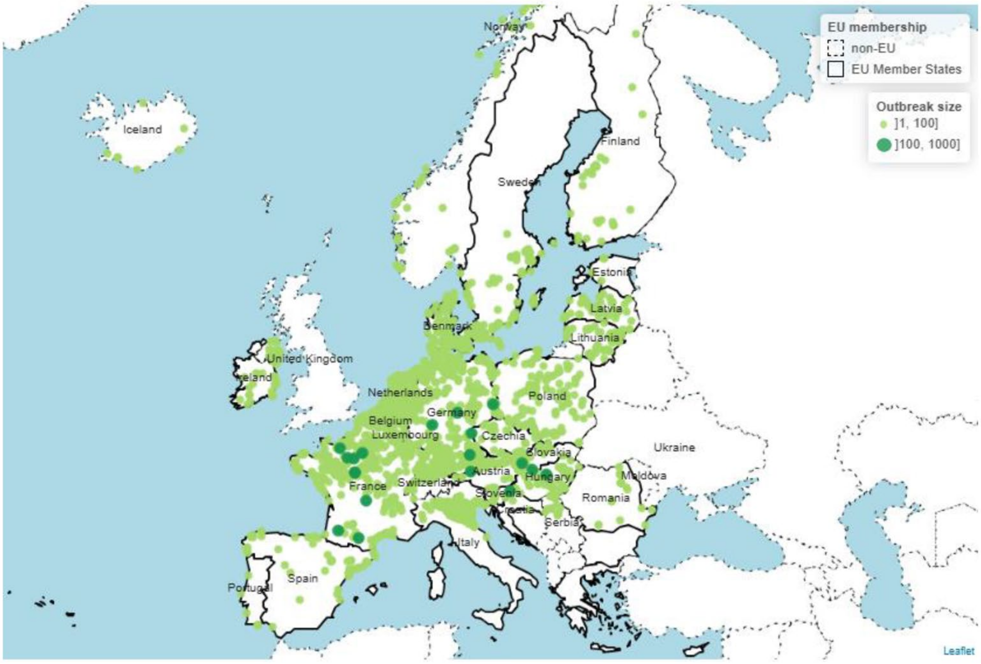

FIGURE 39 [ADIS data] Location and size of the outbreaks in wild birds in 2023 as reported in ADIS by the RCs.
Kosovo – this designation is without prejudice to positions on status and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo Declaration of Independence

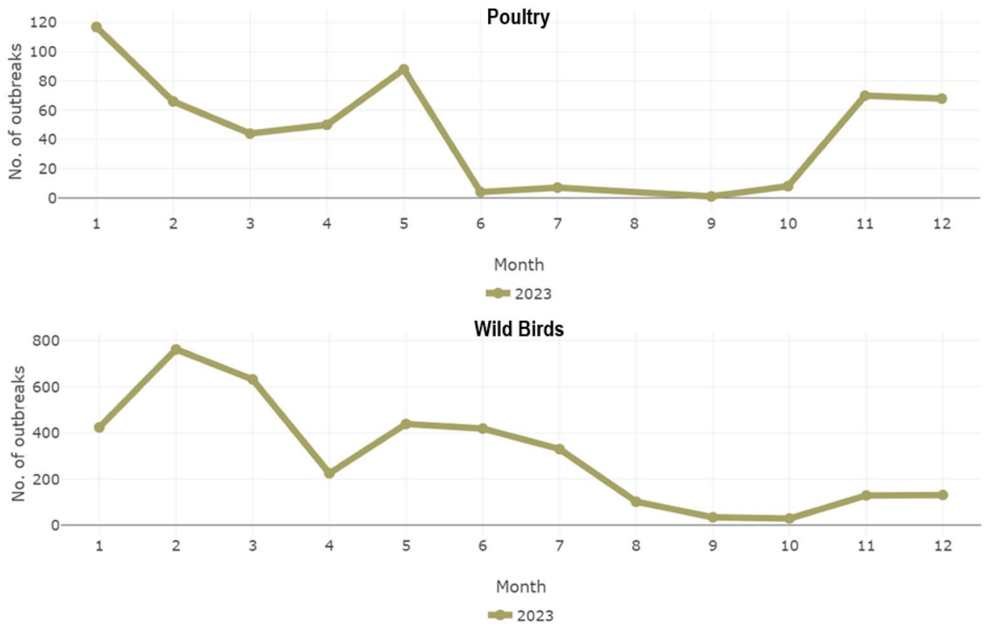

FIGURE 40 [ADIS data] Temporal trend of the outbreaks in poultry (above) and wild birds (below) in 2023 as reported in ADIS by the RCs.

From a temporal perspective, in 2023 the first increase in outbreaks was reported in February in wild or captive birds (see Figure 40 – below), while the peak of outbreaks in the poultry sector was recorded in May.

This pattern could suggest an incursion of the virus through the wild birds migrating from other countries. However, migratory birds generally reach the northern European coasts between late summer and early autumn, with September and October marking peak months for many species. Some of these birds arrive from breeding grounds in the north, such as Scandinavia, Russia and Siberia, where they spend the summer (The Swiss Ornithological Institute). This fact seems to contradict what the trends suggest. More research needs to be performed and the entry into force of the AHL and following legal acts on Avian Influenza, together with the adoption of the new EFSA data collection and the One Health initiatives should provide a more and more detailed overview, providing more elements, in a comprehensive way.

6 | DISCUSSION AND CONCLUSIONS

6.1 | About the scope of this report

This report is the first attempt to describe in a comprehensive and exhaustive way the situation of the Avian Influenza disease in Europe, encompassing all information related to the avian influenza virus, with the objective of having in a unique document the full picture of the disease at European level and bordering countries.

6.2 | General considerations

The risk-based sampling strategies for avian influenza (AI) surveillance vary between countries, which means that the differences observed in this report should be interpreted with caution. It's important to avoid direct comparisons between countries. Additionally, results from virological and serological surveys provide different types of information and should not be compared to draw overarching conclusions about the disease patterns.

A targeted sampling approach increases the efficiency of detecting AI viruses but hinders accurate assessments of disease occurrence, comparing locations, categories, species or tracking trends over time. Comparisons of positivity rates should be limited to the specific observations of a particular survey and cannot be extrapolated to the larger population. Positivity rates are influenced not only by the disease and surveillance methods but also by the effectiveness of the risk-based sampling approach. Therefore, increases in seropositivity rates over time may reflect changes in either the disease situation or improved targeting, rather than actual prevalence or incidence.

The adoption of the SIGMA approach entails the implementation of a new version of the Sample Standard Description v.2 (SSD2) which allows the data providers to submit any type of laboratory data, independently from the programme under which the samples were collected and tested. Reporting countries (RCs) could choose to report their data using either the new 'SIGMA' model or the previous model. This transition has impacted the data collection process, and some of the changes observed between this year and the previous one may be attributed to this shift rather than actual changes in surveillance activities.

6.3 | Poultry

This report for 2023 is the second for which surveillance of AIV is fully framed in the context of the Commission Delegated Regulation (EU) 2020/689. The main change in the new framework is the introduction of virological surveys for ducks, geese and poultry belonging to the species of Anseriformes for supplies of game or quails described as animals that generally don't show any clinical signs. The surveillance activities remain based on risk assessment, which will differ highly between countries. As of last year, and according to the sampling reported by the different countries, three main survey strategies can be observed:

- **mainly based on serological surveys** (Austria, Belgium, Croatia, Cyprus, Finland, France, Germany, Greece, Iceland, Ireland, Latvia, Malta, the Netherlands, Romania, Spain and Switzerland). Out of these, three RCs did not sample any poultry categories that generally don't show any clinical signs (Belgium, Cyprus, Greece), and five only sampled in the '*others*' poultry category (Croatia, Iceland, Latvia, Malta and Switzerland)
- **mainly based on virological surveys** (Hungary, Denmark, Estonia, Lithuania and United Kingdom (Northern Ireland))
- **based on both virological and serological surveys** depending on poultry categories with preferentially virology used when PEs hold species that generally don't show clinical signs (Bulgaria, Czechia, Italy, Luxembourg, Norway, Poland, Portugal, Slovakia, Slovenia and Sweden).

Hence when describing the results from serological or virological surveys, the contribution of each country will not only vary according to their specific context but also of their risk-based sampling strategies.

An increasing trend in the number of PEs sampled for serology was observed between 2017 and 2019 until a plateau above 24,000 PEs sampled per year was reached from 2019 to 2021. However, in 2022, this trend stopped as the number of PEs dropped to 21,183 (18,490 PEs sampled for serology and 3775 PEs sampled for virology). A similar situation was observed in 2023 with a total of 21,183 PEs sampled (18,723 PEs sampled for serology and 2626 PEs sampled for virology) despite a few fewer PEs sampled for virology. This change resulted from modifying the sampling strategies in different RCs as the Commission Delegated Regulation (EU) 2020/689 was implemented.

Among the surveyed PEs, 27 were seropositive for A (H5) viruses; one was seropositive to A(H7) and one was seropositive to both A(H5) and A(H7). Similarly, 178 PEs were PCR-positive for A(H5) viruses, and 2 PEs were for A(H7) viruses. These minor incursions of A(H7) viruses in poultry were not identified in the wild bird population in 2023. This situation is a shift from 2022 when no A(H7) viruses were identified in any population, and from previous years, where A(H7) viruses were identified in both PEs and wild birds (EFSA, Aznar, et al., 2022; EFSA, Aznar, et al., 2023.).

In 2023, A(H5)-positive PEs from 14 different poultry categories varied from 0 to 76 positive PEs monthly. The monthly detection resembles a seasonal pattern (break in detection in August and September) as in previous HPAI A(H5Nx) epidemics before 2022. Furthermore, out of the 178 A(H5)-positive PEs, 161 were positive for HPAI A(H5N1). The patterns probably coincidentally follow the one observed in 2023 in the number of HPAI A(H5N1) positive samples in waterfowls; similar observations were made when monitoring outbreaks in 2023 (EFSA, ECDC, EURL, et al., 2023; Fusaro et al., 2024).

This epidemic was associated with 1385, 2771 and 1314 outbreaks during the 2020–2021, 2021–2022 and 2022–2023 epidemic seasons in domestic birds, respectively (EFSA, ECDC, EURL, et al., 2024). The outbreaks were mainly identified through early detection surveillance. It has been the largest HPAI A(H5Nx) epidemic recorded in the EU since the 2016–2017 epidemic. The outbreaks in Europe are linked with a wider epidemic of A(H5N1) viruses of clade 2.3.4.4b (EFSA, ECDC, et al., 2022), which was first described in late 2016 at the Qinghai Lake in China and the Lake Uvs-Nuur in Russia (Lewis et al., 2021.; Verhagen et al., 2021). Since then, it has spread to Europe and Africa. These A(H5N1) viruses of clade 2.3.4.4b were also introduced via the Atlantic flyway to North America in 2021 and later spread to Central and South America in 2022 (Caliendo, Leijten, et al., 2022).

The serological test results by poultry categories in 2023 were similar to previous years despite a higher number of seropositive PEs (EFSA, Aznar, et al., 2023). While the highest risk of circulation of A(H5/H7) viruses continues to be in aquatic birds (game birds, breeding geese and ducks), gallinaceous birds (in particular chickens and turkeys, who were more sampled), were at low risk overall. Hence, in 2023, backyard establishments, conventional and free-range laying hens, breeding chickens and growers accounted for the largest numbers tested; only one A(H5)-seropositive PE was identified at a conventional laying hen establishment. Those results highlight the low level of LPAI A(H5/H7) viruses circulating among high-risk poultry species (conventional and free-range laying hens, breeding turkeys, fattening turkeys and game birds (gallinaceous)) as defined in the Commission Delegated Regulation (EU) 2020/689.[19]

Furthermore, MSs are also required to follow-up supplement PEs with positive serological tests by performing PCR tests on the same flock. Unlike previous years, follow-up PCR results were available for only 13 A(H5)-seropositive PEs, and in all cases, follow-up in neighbouring flocks was not considered.[20] All follow-up PCR occurred in Anseriformes holding establishments except for one chicken establishment. Only four of these seropositive PEs tested positive by PCR: three with AIVS

[19]https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.084.01.0001.01.ENG.

[20]If follow-up testing was conducted on neighbouring flocks rather than on the same flock (i.e. with a different holding identifier), these events can be reported by MSs using the feature in the data collection dedicated to reporting follow-up activities ('sampInfo_origSampId'). However, in this report, only direct follow-ups were conducted as no identifiers were provided or the provided identifiers were not those used in the reported information.

(whose subtype and pathogenicity were not reported) and one A(H1N2) virus in waterfowl game birds in Spain. With so little information, it is not easy to further describe patterns in this high-risk and targeted population.

Active surveillance provides valuable insights into the circulation of AIVs in PEs, in particular for LPAIVs and poultry species or categories which are mostly sub-clinically affected. However, the sensitivity of such a surveillance approach remains limited, as it does not provide high coverage in terms of population and time. Therefore, different surveillance approaches should be carefully considered when interpreting the present results. Finally, it is useful to note that data on the distribution and composition of the underlying poultry population have started to be collected and processed by EFSA. Once done, it should provide a better understanding of the underlying population for the different poultry categories as well as the RCs' sampling schemes, which should improve the interpretation of the AI surveillance results at the European level.

6.4 | Wild birds

In 2023, 34,143 wild birds were tested by passive surveillance by all 31 RCs, significantly higher than in the past 4 years. Fifteen countries also reported 17,268 wild birds sampled under active surveillance activities.

The number of sampled wild birds that tested positive increased 1.6-fold from 2022 to 2023. Among these 6171 HPAI-positive wild birds, 6626 were found dead and sampled by passive surveillance programmes. These values continue to support the importance of this surveillance approach for AI surveillance in wild bird species. Unlike 2022, even though sampling was distributed uniformly across 2023, HPAIV-positive wild birds were detected in two waves, one in winter and another in spring, with a very low detection rate at the end of summer and a slow increase by the end of the year (November–December). This unusual pattern is neither the specific seasonal patterns identified in the 2019–2020, 2020–2021 and 2021–2022 epidemic seasons nor the fluctuating baseline observed in 2022.

In 2022, the report described evidence of the shift in the epidemiology of A(H5N1) viruses of clade 2.3.4.4b circulating in European wild birds. This process could have begun in 2021, as a sublineage of the A(H5N1) viruses of clade 2.3.4.4b could have been maintained. Evidence of maintenance has presumably been found in northern Europe throughout the summer of 2021 and in hunted birds in Italy during the winter of 2020–2021 (Caliendo, Lewis, et al., 2022., Pohlmann et al., 2022). In 2023, low maintenance of the disease circulation was observed even at the end of the summer in Europe, with sporadic HPAIV detections in wild birds compared to the beginning of 2023 and 2022.

The observed temporal fluctuations in 2023 were also associated with different proportions of HPAIV-positive orders. The first quarter involved mainly Charadriiformes, but with a significant number of Anseriformes; the second just Charadriiformes; the third very few positives; and the fourth just Anseriformes. Association between HPAIV detection rate and specific species were also observed in the monitoring reports across the year (EFSA, ECDC, EURL, et al., 2023., EFSA, ECDC, EURL, et al., 2023., EFSA, ECDC, EURL, et al., 2023., EFSA, ECDC, EURL, et al. 2023d). Furthermore, there was a change in the spatial distribution of HPAIV detections between 2022 and 2023. If detections were observed along the eastern coast of Europe: from the Atlantic, along the English Channel and north to the Baltic Sea in 2022 (EFSA, Aznar, et al., 2023), in 2023, multiple HPAIV detections occurred in the northern central parts of Europe. These quick changes in patterns, even across a year, underline the complex association between diverse species population and their interaction with a diversity of genotypes and subtypes. For example, in 2022, the EA-2022-BB A(H5N1) subtype primarily circulated in gulls (Laridae) with differentiated waves of contamination first across European Herring gulls and later black-headed gulls. However, this genotype was not observed in species from the Anseriformes order (Fusaro et al., 2024, EFSA, ECDC, EURL, et al., 2023., EFSA, ECDC, EURL, et al., 2023., EFSA, ECDC, EURL, et al., 2023., EFSA, ECDC, EURL, et al. 2023d). This appears to be an example of a new subtype taking an opportunity to occupy a new ecological niche. The increase in genotypes, subtypes and the host of A(H5N1) makes trends and evolution harder to predict (Fusaro et al., 2024).

Furthermore, in 2023, RCs also detected 1940 AIVS other than HPAIs, including 1372 non-A(H5/H7) viruses LPAIV, among which only 62 were typed. If efforts are not centred on not typing non-A(H5/H7) viruses, it must be highlighted that some information about LPAIV is central to understanding virological dynamics. The 2020–2021 and 2021–2022 waves were characterised by the circulation of a large variety of subtypes and genotypes resulting from reassortment events with LPAI viruses (Fusaro et al., 2024). Following and understanding the genotypes and subtypes of circulating viruses is even more critical considering the multiple mammal incursions that occurred in 2023 and 2024. For example, understanding reassortment and genotype can provide important epidemiological insights into events, such as the incursion of A(H5N1) virus in cattle in the United States (Nguyen et al., 2024), or monitor the risk to humans (EFSA, 2024.).

In 2023, 59% of the sampled wild birds were identified at the species level. This is lower than the 84% of the sampled wild birds in 2022 but higher than in 2022 (50%). Recognising the efforts undertaken for sampling by all RCs, ongoing work to maintain a high level of species identification allows this information to be leveraged to describe, analyse and understand the complex relationship between AIV strains and wild bird diversity and interactions. More specially, this information supports the development of mechanistic models to predict the risk of virus introduction in a territory such as Bird Flu Radar developed by EFSA and BTO (Bird Trust for Ornithology).[21]

Additionally, population information from wild birds is central to the surveillance of AIVS. Summary data provided by the EBP project are presented to describe the number of wild bird observations reported by voluntary contributors in

[21] https://app.bto.org/mmt/avian_influenza_map/avian_influenza_map.jsp.

2023. These data may provide some context regarding the performance of passive surveillance of AI in wild birds in the EU. However, it is essential to note that the density of wild bird observations is the product of two factors:

- the density of wild birds (which depends on species-specific factors such as the location, biotope, time of the year, etc.),
- the probability that a wild bird is observed by someone and reported in a relevant database, given that it is present. This is also known as the 'effort' put into wild bird observations.

Consequently, areas with a low density of observations may correspond to areas where the sensitivity of passive surveillance is low due to a lower 'effort', or to habitats which are not favourable to birds (low density of birds), or both. A previous study in Sweden warned that voluntary contributor-based data should be used with care, given the limitations of this data collection method (Snäll et al., 2011). Despite the limitations of the voluntary observation data presented in this report, and until further spatial modelling of the distribution of wild birds in Europe by species is readily available, the maps presented in this report (and also those linked to this report and shown in Zenodo[22]) may help to shed light on areas where the wild birds of the species belonging to the target list may gather, supporting RCs in carrying out more targeted surveillance activities.

ABBREVIATION

AI	Avian influenza
AIV	Avian influenza A virus
H	Haemagglutinin
HPAI	High pathogenic avian influenza
HPAIV	Highly pathogenic avian influenza viruses
LPAI	Low pathogenic avian influenza
LPAIV	Low pathogenic avian influenza viruses
MS	Member State
N	Neuraminidase
NUTS	Nomenclature of Territorial Units for Statistics
PE	Poultry Establishment
RC	Reporting Country

ACKNOWLEDGEMENTS

EFSA wishes to thank the following for the support provided to this scientific output: Camille Delavenne from Epimundi for the support to the analysis; the Member State representatives for the review; Fernanda Dòrea and Hans Herman Thulke for the peer review. EFSA wishes to thank all European competent institutions, Member State bodies and other organisations that provided data for this scientific output. Roxani Aminalragia-Giamini for the support in the data collection and management.

REQUESTOR

European Commission

QUESTION NUMBER

EFSA-Q-2023-00580

MAP DISCLAIMER

The designations employed and the presentation of material on any maps included in this scientific output do not imply the expression of any opinion whatsoever on the part of the European Food Safety Authority concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Any designation of Kosovo is without prejudice to positions on status and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo Declaration of Independence

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[22]https://zenodo.org/uploads/14515393.

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How to cite this article: EFSA (European food Safety Authority), Abrahantes, J. C., Aznar, I., Catalin, I., Kohnle, L., Mulligan, K. F., Mur, L., Stoicescu, A., van Houtum, A., & Zancanaro, G. (2025). Avian influenza annual report 2023. *EFSA Journal*, *23*(1), e9197. https://doi.org/10.2903/j.efsa.2025.9197

APPENDIX A

Data analysis performed on joint data

These tables report the results performed on data obtained by merging the data submitted using the SIGMA-SSD2 standards (back transformed) and data submitted using the previous standards.

Note that the over-representation of the 'Other' category is an artefact due to the following reasons:

(1) the data analysis is performed on the joint laboratory, i.e. a data frame composed by data submitted in the old format and back-transformed data submitted with the new standards. As in the old data model the 'purpose of raising' was not collected, this information submitted with the new standards might be always considered, leading to misclassifications.

(2) in the new laboratory data model, the 'purpose of raising' was optional. Countries like Croatia, Czechia (partly), Iceland, Latvia, Malta, Slovakia (partly) and Switzerland did not report this information when submitting laboratory data. This artefact will be addressed in the next data collection with the re-introduction of commercial terms (e.g. broilers, laying hens, etc.).

	Laying Hens	Free-Range Laying Hens	Breeding Chickens	Broilers (Heightened Risk)	Breeding Turkeys	Fattening Turkeys	Breeding Ducks	Fattening Ducks	Breeding Geese	Fattening Geese	Growers	Backyard Flocks	Game Birds (Gallinaceous)	Game Birds (Waterfowl)	Ratites	Others
Austria	268		30	1		52		54		48					6	
Belgium												47	16			433
Bulgaria	55		19	3	1		7	648				1	6			38
Croatia																242
Cyprus	20	13	9	2		4						41	3			
Czechia													27			129
Finland	70		34	3	3	48		1		1			9	3		
France	112		54		59	53	69		25				49	15		288
Germany	180		8	13	10	128	15	152	1	141					23	61
Greece	94		42	14	3	21					29		3			
Iceland																31
Ireland	90		99	57	5	79	6	24	2	1			4			
Italy	612	181	198		27	316					1,968		37		11	
Latvia																91
Luxembourg	4	10		2											8	
Malta																23
Netherlands	1,121	1,562	772	971		110	18	35								
Norway	80		87		5	44	2	10		1		1				
Poland	241		164	1	20	177	39	135	105	142		1	37			2
Portugal	169					65							2			
Romania	499		134			96					10	2,629	16	3	4	
Slovakia													11			92
Slovenia	94		7			39		15				76	3			
Spain	117	46	122	3	5	68	2	38	2	16		15	189	37		14
Sweden	6		30		3	34	5	3	5	3				5		
Switzerland																126

FIGURE A.1 Total number of PEs sampled for serology, presented by RCs and poultry category, according to 16 poultry categories. The colours indicate the poultry categories with the smallest (lightest grey shade) to the largest (darkest grey shade) number of PEs sampled within a given RC.

	Laying Hens	Free-Range Laying Hens	Breeding Chickens	Broilers (Heightened Risk)	Breeding Turkeys	Fattening Turkeys	Breeding Ducks	Fattening Ducks	Breeding Geese	Fattening Geese	Growers	Backyard Flocks	Game Birds (Gallinaceous)	Game Birds (Waterfowl)	Ratites	Others
Bulgaria	46		3	20		1	17	362				3	5			13
Croatia																7
Czechia														6		103
Denmark													2	45		26
Estonia																37
Finland										1				3		
Germany	3		4		1	4	1	1		2						36
Greece											1		12			
Hungary													21		2	636
Iceland																4
Italy				8		5	8	76	5	4		175	8	1		
Latvia																6
Lithuania																40
Luxembourg		6		1								34				
Netherlands		7														
Norway	8		15	1			2		1			7	1	3		3
Poland	11		1	34		45	9	65	28	38		30	6			52
Portugal							4	47					41	6		
Slovakia													1			26
Slovenia	59		12	40		31				3		45			2	1
Spain	4		2	1		9	1	14	1	2		5	15	4		
Sweden								2		2				5		
United Kingdom (Northern Ireland)													4			66

FIGURE A.2 Total number of PEs sampled for virology, presented by RCs and poultry category, according to 17 poultry categories. The colours are used to indicate the poultry categories with the smallest (lightest blue shade) to the largest (darkest blue shade) number of PEs sampled within a given RC.

In accordance with the Agreement on the Withdrawal of the UK from the EU, and in particular with the Windsor Framework, the EU requirements on data sampling also apply to Northern Ireland.

APPENDIX B

Scientific and common names of wild bird species

TABLE B.1 English common names and scientific names of wild bird species sampled in 2023.

Scientific name	English common name
Acanthis flammea	Redpoll
Accipiter gentilis	Northern goshawk
Accipiter nisus	Eurasian sparrowhawk
Acridotheres cristatellus	Crested myna
Acrocephalus schoenobaenus	Sedge warbler
Acrocephalus scirpaceus	Common reed-warbler
Actitis hypoleucos	Common sandpiper
Aegithalos caudatus	Long-tailed tit
Aegolius funereus	Boreal owl
Aegypius monachus	Cinereous vulture
Agropsar sturninus	Purple-backed starling
Aix galericulata	Mandarin duck
Alauda arvensis	Eurasian skylark
Alca torda	Razorbill
Alcedo atthis	Common kingfisher
Alectoris chukar	Chukar
Alectoris graeca	Rock partridge
Alectoris rufa	Red-legged partridge
Alle alle	Little auk
Alopochen aegyptiaca	Egyptian goose
Anas acuta	Northern pintail
Anas crecca	Common teal
Anas platyrhynchos	Mallard
Anser albifrons	Greater white-fronted goose
Anser anser	Greylag goose
Anser brachyrhynchus	Pink-footed goose
Anser caerulescens	Snow goose
Anser cygnoides	Swan goose
Anser erythropus	Lesser white-fronted goose
Anser fabalis	Bean goose
Anser indicus	Bar-headed goose
Apus apus	Common swift
Apus pallidus	Pallid swift
Aquila adalberti	Spanish imperial eagle
Aquila chrysaetos	Golden eagle
Aquila fasciata	Bonelli's eagle
Aquila heliaca	Eastern imperial eagle
Ardea alba	Great white egret
Ardea cinerea	Grey heron
Ardea purpurea	Purple heron
Ardenna grisea	Sooty shearwater
Arenaria interpres	Ruddy turnstone
Asio flammeus	Short-eared owl
Asio otus	Northern long-eared owl
Athene noctua	Little owl

TABLE B.1 (Continued)

Scientific name	English common name
Aythya americana	Redhead
Aythya ferina	Common pochard
Aythya fuligula	Tufted duck
Aythya marila	Greater scaup
Aythya nyroca	Ferruginous duck
Bombycilla garrulus	Bohemian waxwing
Bonasa bonasia	Hazel grouse
Botaurus stellaris	Eurasian bittern
Branta bernicla	Brent goose
Branta canadensis	Canada goose
Branta hutchinsii	Cackling goose
Branta leucopsis	Barnacle goose
Bubo bubo	Eurasian eagle-owl
Bubo scandiacus	Snowy owl
Bubulcus ibis	Cattle egret
Bucephala clangula	Common goldeneye
Bucorvus abyssinicus	Abyssinian ground hornbill
Burhinus oedicnemus	Eurasian thick-knee
Buteo buteo	Eurasian buzzard
Buteo lagopus	Rough-legged buzzard
Buteo rufinus	Long-legged buzzard
Butorides striata	Green-backed heron
Cairina moschata	Muscovy duck
Calidris alba	Sanderling
Calidris alpina	Dunlin
Calidris canutus	Red knot
Calidris maritima	Purple sandpiper
Calidris pugnax	Ruff
Calonectris borealis	Cory's shearwater
Calonectris diomedea	Scopoli's shearwater
Caprimulgus europaeus	European nightjar
Carduelis carduelis	European goldfinch
Catharacta skua	Great skua
Cathartes aura	Turkey vulture
Certhia familiaris	Eurasian treecreeper
Cettia cetti	Cetti's warbler
Charadrius alexandrinus	Kentish plover
Chlidonias hybrida	Whiskered tern
Chlidonias niger	Black tern
Chloris chloris	European greenfinch
Ciconia ciconia	White stork
Ciconia nigra	Black stork
Circaetus gallicus	Short-toed snake-eagle
Circus aeruginosus	Western marsh-harrier
Circus cyaneus	Hen harrier
Circus pygargus	Montagu's harrier
Clangula hyemalis	Long-tailed duck
Coccothraustes coccothraustes	Hawfinch
Columba livia	Rock dove

(Continues)

TABLE B.1 (Continued)

Scientific name	English common name
Columba oenas	Stock dove
Columba palumbus	Common woodpigeon
Coracias garrulus	European roller
Corvus corax	Common raven
Corvus corone	Carrion crow
Corvus coronus	Hooded crow
Corvus frugilegus	Rook
Corvus monedula	Eurasian jackdaw
Coturnix coturnix	Common quail
Crex crex	Corncrake
Cuculus canorus	Common cuckoo
Cyanecula svecica	Bluethroat
Cyanistes caeruleus	Eurasian blue tit
Cyanocorax yncas	Inca jay
Cyanopica cooki	Iberian azure-winged magpie
Cygnus atratus	Black swan
Cygnus columbianus	Tundra swan
Cygnus cygnus	Whooper swan
Cygnus olor	Mute swan
Delichon urbicum	Northern house martin
Dendrocopos leucotos	White-backed woodpecker
Dendrocopos major	Great spotted woodpecker
Dendrocopos syriacus	Syrian woodpecker
Dendrocygna bicolor	Fulvous whistling-duck
Dryocopus martius	Black woodpecker
Egretta garzetta	Little egret
Elanus caeruleus	Black-winged kite
Emberiza cirlus	Cirl bunting
Emberiza citrinella	Yellowhammer
Erithacus rubecula	European robin
Eudocimus ruber	Scarlet ibis
Falco cherrug	Saker falcon
Falco columbarius	Merlin
Falco naumanni	Lesser kestrel
Falco peregrinus	Peregrine falcon
Falco rusticolus	Gyrfalcon
Falco subbuteo	Eurasian hobby
Falco tinnunculus	Common kestrel
Falco vespertinus	Red-footed falcon
Ficedula hypoleuca	European pied flycatcher
Francolinus francolinus	Black francolin
Fratercula arctica	Atlantic puffin
Fringilla coelebs	Common chaffinch
Fulica atra	Common coot
Fulmarus glacialis	Northern fulmar
Gallinago gallinago	Common snipe
Gallinago media	Great snipe
Gallinula chloropus	Common moorhen
Garrulus glandarius	Eurasian jay

TABLE B.1 (Continued)

Scientific name	English common name
Gavia arctica	Arctic loon
Gavia immer	Common loon
Gavia stellata	Red-throated loon
Gelochelidon nilotica	Common gull-billed tern
Geronticus eremita	Northern bald ibis
Glaucidium passerinum	Eurasian pygmy-owl
Grus grus	Common crane
Gypaetus barbatus	Bearded vulture
Gyps fulvus	Griffon vulture
Haematopus ostralegus	Eurasian oystercatcher
Haliaeetus albicilla	White-tailed eagle
Haliaeetus leucoryphus	Pallas's fish-eagle
Hieraaetus pennatus	Booted eagle
Himantopus himantopus	Black-winged stilt
Hippolais icterina	Icterine warbler
Hirundo rustica	Barn swallow
Hydrobates leucorhous	Leach's storm-petrel
Hydrobates pelagicus	European storm-petrel
Hydrocoloeus minutus	Little gull
Hydroprogne caspia	Caspian tern
Ixobrychus minutus	Common little bittern
Jynx torquilla	Eurasian wryneck
Lagopus lagopus	Willow grouse
Lagopus muta	Rock ptarmigan
Lanius collurio	Red-backed shrike
Lanius excubitor	Great grey shrike
Larus argentatus	European herring gull
Larus audouinii	Audouin's gull
Larus cachinnans	Caspian gull
Larus canus	Mew gull
Larus fuscus	Lesser black-backed gull
Larus genei	Slender-billed gull
Larus glaucescens	Glaucous-winged gull
Larus marinus	Great black-backed gull
Larus melanocephalus	Mediterranean gull
Larus michahellis	Yellow-legged gull
Larus ridibundus	Black-headed gull
Leiopicus medius	Middle spotted woodpecker
Leiothrix lutea	Red-billed leiothrix
Limosa lapponica	Bar-tailed godwit
Limosa limosa	Black-tailed godwit
Linaria cannabina	Common linnet
Linaria flavirostris	Twite
Locustella naevia	Common grasshopper-warbler
Loxia curvirostra	Red crossbill
Luscinia luscinia	Thrush nightingale
Luscinia megarhynchos	Common nightingale
Lyrurus tetrix	Black grouse
Mareca penelope	Eurasian wigeon

(Continues)

TABLE B.1 (Continued)

Scientific name	English common name
Mareca strepera	Gadwall
Marmaronetta angustirostris	Marbled teal
Melanitta fusca	Velvet scoter
Melanitta nigra	Common scoter
Mergellus albellus	Smew
Mergus merganser	Goosander
Mergus serrator	Red-breasted merganser
Merops apiaster	European bee-eater
Milvus migrans	Black kite
Milvus milvus	Red kite
Morus bassanus	Northern gannet
Morus capensis	Cape gannet
Motacilla alba	White wagtail
Motacilla flava	Western yellow wagtail
Muscicapa striata	Spotted flycatcher
Myiopsitta monachus	Monk parakeet
Neophron percnopterus	Egyptian vulture
Netta rufina	Red-crested pochard
Nucifraga caryocatactes	Northern nutcracker
Numenius arquata	Eurasian curlew
Numida meleagris	Helmeted guineafowl
Nycticorax nycticorax	Black-crowned night-heron
Oenanthe oenanthe	Northern wheatear
Oriolus oriolus	Eurasian golden oriole
Otis tarda	Great bustard
Otus scops	Eurasian scops-owl
Oxyura leucocephala	White-headed duck
Pandion haliaetus	Osprey
Panurus biarmicus	Bearded reedling
Parabuteo unicinctus	Harris's hawk
Parus major	Great tit
Passer domesticus	House sparrow
Passer hispaniolensis	Spanish sparrow
Passer montanus	Eurasian tree sparrow
Pavo cristatus	Peafowl
Pelecanus crispus	Dalmatian pelican
Pelecanus onocrotalus	Great white pelican
Perdicinae	Partridge
Perdix perdix	Grey partridge
Periparus ater	Coal tit
Pernis apivorus	European honey-buzzard
Phalacrocorax aristotelis	European shag
Phalacrocorax carbo	Great cormorant
Phalaropus fulicarius	Red phalarope
Phasianus colchicus	Common pheasant
Phoeniconaias minor	Lesser flamingo
Phoenicopterus chilensis	Chilean flamingo
Phoenicopterus roseus	Greater flamingo
Phoenicopterus ruber	American flamingo

TABLE B.1 (Continued)

Scientific name	English common name
Phoenicurus ochruros	Black redstart
Phoenicurus phoenicurus	Common redstart
Phylloscopus collybita	Common chiffchaff
Phylloscopus trochilus	Willow warbler
Pica pica	Eurasian magpie
Picus canus	Grey-faced woodpecker
Picus viridis	Eurasian green woodpecker
Platalea leucorodia	Eurasian spoonbill
Plegadis falcinellus	Glossy ibis
Pluvialis apricaria	Eurasian golden plover
Pluvialis squatarola	Grey plover
Podiceps cristatus	Great crested grebe
Podiceps nigricollis	Black-necked grebe
Poecile palustris	Marsh tit
Porphyrio porphyrio	Purple swamphen
Porzana porzana	Spotted crake
Prunella modularis	Dunnock
Psittacula krameri	Rose-ringed parakeet
Psittacus erithacus	Grey parrot
Ptyonoprogne rupestris	Eurasian crag martin
Puffinus assimilis	Little shearwater
Puffinus puffinus	Manx shearwater
Pyrrhocorax graculus	Yellow-billed chough
Pyrrhula pyrrhula	Eurasian bullfinch
Rallus aquaticus	Western water rail
Recurvirostra avosetta	Pied avocet
Regulus ignicapilla	Common firecrest
Regulus regulus	Goldcrest
Rissa tridactyla	Black-legged kittiwake
Saxicola	Saxicola
Scolopax rusticola	Eurasian woodcock
Serinus canaria	Island canary
Serinus serinus	European serin
Sitta europaea	Eurasian nuthatch
Somateria mollissima	Common eider
Spatula clypeata	Northern shoveler
Spatula querquedula	Garganey
Spinus spinus	Eurasian siskin
Stercorarius parasiticus	Arctic jaeger
Stercorarius pomarinus	Pomarine jaeger
Sterna dougallii	Roseate tern
Sterna hirundo	Common tern
Sterna paradisaea	Arctic tern
Sternula albifrons	Little tern
Streptopelia decaocto	Eurasian collared-dove
Streptopelia turtur	European turtle-dove
Strix aluco	Tawny owl
Strix nebulosa	Great grey owl
Strix uralensis	Ural owl

(Continues)

TABLE B.1 (Continued)

Scientific name	English common name
Struthio camelus	Ostrich
Sturnus unicolor	Spotless starling
Sturnus vulgaris	Common starling
Sula sula	Red-footed booby
Surnia ulula	Northern hawk-owl
Sylvia atricapilla	Eurasian blackcap
Sylvia borin	Garden warbler
Sylvia communis	Common whitethroat
Sylvia melanocephala	Sardinian warbler
Tachybaptus ruficollis	Little grebe
Tachymarptis melba	Alpine swift
Tadorna ferruginea	Ruddy shelduck
Tadorna tadorna	Common shelduck
Tetrao urogallus	Western capercaillie
Tetrax tetrax	Little bustard
Thalasseus sandvicensis	Sandwich tern
Threskiornis aethiopicus	African sacred ibis
Tringa totanus	Common redshank
Troglodytes troglodytes	Northern wren
Turdus merula	Eurasian blackbird
Turdus philomelos	Song thrush
Turdus pilaris	Fieldfare
Turdus viscivorus	Mistle thrush
Tyto alba	Common barn-owl
Upupa epops	Common hoopoe
Uria aalge	Common murre
Vanellus spinosus	Spur-winged lapwing
Vanellus vanellus	Northern lapwing
Zapornia pusilla	Baillon's crake

ANNEXES

Annex A lists the DOIs pointing to the raw laboratory data on Avian Influenza stored in Zenodo

Annex B lists the DOIs pointing to the raw data on poultry population stored in Zenodo

Both annexes are available under the Supporting Information section on the online version of the scientific output.