

First Detection of Highly Pathogenic Avian Influenza Virus in Norway

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Abstract

Background: Several outbreaks of highly pathogenic avian influenza (HPAI) caused by influenza A virus of subtype H5N8 have been reported in wild birds and poultry in Europe during autumn 2020.

Norway is one of the few countries in Europe that had not previously detected HPAI virus, despite widespread active monitoring of both domestic and wild birds since 2005.

Results: We report detection of HPAI virus subtype H5N8 in a wild pink-footed goose (*Anser brachyrhynchus*), and several other geese, ducks and a gull, from south-western Norway in November and December 2020. Despite previous reports of low pathogenic avian influenza (LPAI), this constitutes the first detections of HPAI in Norway.

Conclusions: The mode of introduction is unclear, but a northward migration of infected geese or gulls from Denmark or the Netherlands during the autumn of 2020 is currently our main hypothesis for the introduction of HPAI to Norway. Although HPAI of subtype H5N8 has been reported to have very low zoonotic potential, this is a reminder that HPAI with greater zoonotic potential in wild birds may pose a threat in the future.

Background

Influenza A viruses are common in wild birds worldwide, especially in species within the orders of *Anseriformes* (ducks, geese, and swans) and *Charadriiformes* (gulls, terns, and shorebirds) (1).

Several outbreaks of highly pathogenic avian influenza have affected domestic poultry and wild birds in Europe in recent years, and Influenza A virus of subtypes H5N1 and H5N8 have predominated (2). Viruses from the H5N8 Gs/GD clade 2.3.4.4 Group B, originally from Asia, were found to be highly pathogenic in geese in 2016/2017 (3). Since August 15th 2020, outbreaks of HPAI have been detected in 15 EU/EEA countries and the UK, with subtype H5N8 as the most reported subtype (4). Mainly wild waterbirds, such as barnacle goose (*Branta leucopsis*), greylag goose (*Anser anser*), Eurasian wigeon (*Mareca penelope*) and mallard (*Anas platyrhynchos*) were affected, but there have also been a few outbreaks in poultry and captive birds.

Norway is one of the few countries in Europe that had not previously detected HPAI virus, despite widespread active monitoring of both domestic and wild birds since 2005 (2, 5). Prevalence of influenza A virus in ducks and gulls varied between 5.7–18.4% in the period 2005–2019 in Norway, all being low pathogenic avian influenza (LPAI) virus (5).

Results

On November 27th 2020, the Norwegian Veterinary Institute (NVI) notified the Norwegian Food Safety Authority (NFSA) of a confirmed case of HPAI virus subtype H5N8 in a wild pink-footed goose (*Anser*

brachyrhynchus) from Sandnes municipality, in Rogaland County (Fig. 1). The goose was found in a diseased state and died on the 22nd of November 2020. Despite previous reports of LPAI, this constitutes the first detection of HPAI in Norway.

Virus detection was performed with real-time RT-PCR targeting the matrix gene of the Influenza A virus. This was followed by subtype-specific PCRs and sequencing of the cleavage site of the haemagglutinin molecule for determination of the pathogenicity following the protocols from the Animal and Plant Health Agency (6).

The sequence result showed that the virus belongs to the clade 2.3.4, like other H5N8 viruses detected in wild birds, poultry and turkey in neighbouring countries in 2020. As a national reference laboratory for influenza in animals, NVI will also submit sample material to the EU reference laboratory for further characterization of the virus and an epidemiological overview.

As of the 22nd of December 2020, HPAI virus of subtype H5N8 has been detected in ten wild and four captive birds, all in Southern Norway (Table 1).

A great black-backed gull (*Larus marinus*) was observed sick for a couple of days in Bergen municipality, Vestland county, and died on the 29th of November 2020. Bergen is around 170 km north of Sandnes (Fig. 1, Table 1). Additionally, another A(H5N8) positive pink-footed goose was discovered in Klepp municipality, Rogaland, about 15 km from the index case; the goose displayed no clinical symptoms and was shot during regular hunting.

A captive turkey (*Meleagris gallopavo f. domestica*) and three roosters (*Gallus gallus domesticus*) were found dead in late November and early December, respectively, in a publicly operated bird park in Hå municipality, about 15 km south of Sandnes (Fig. 1, Table 1).

Four Eurasian wigeons shot during the regular hunting season in mid-November in Klepp municipality were positive for HPAI of subtype H5N8 (Table 1). Samples from these birds were submitted to NVI as a part of the ongoing active surveillance program for avian influenza viruses in Norway. Another two Eurasian wigeons shot in mid-November were found positive for influenza A virus of subtype H5N8, but sequencing of the cleavage site has not been successful.

Further, HPAI H5N8 was also detected in a Eurasian wigeon that was found dead in Randaberg municipality, Rogaland, in early December and a barnacle goose that was found dead in Evje and Hornnes municipality, Agder county, in mid-December (Fig. 1, Table 1).

Discussion

The wetland areas in Jæren, in Rogaland county in south-western Norway (Fig. 1), are important habitats for migratory birds during the autumn, winter and spring roosts (7). Jæren also has Norway's highest density of poultry farms, which entails a risk for outbreaks of HPAI in poultry farms (8). It was thus not a surprise that the first detection of HPAI in Norway happened in Rogaland. However, the timing of HPAI

virus introduction to Norway was more unforeseen, since the influx of potentially infected birds from central Europe during the spring migration was considered to pose the greatest risk to Norway (8).

The population of Pink-footed geese that breed in the Arctic archipelago of Svalbard, migrate through Norway in the autumn, from mid-September to late October (9). The majority of the birds stage in Trøndelag county, where they are subject to regular hunting. After the staging period, they continue their migration southward, crossing inland to the Oslofjord and further to Denmark. Some birds, however, migrate along the western coast of Norway, and some stage in the wetlands of Jæren in Rogaland (Fig. 1). Most birds belonging to this population winter in the Netherlands and Belgium (9).

Observations from neck banded birds indicate regular short distance return migrations from other North Sea countries to Southern Norway (10). In line with this, recent results from a goose fitted with a GPS-logger indicate that pink-footed geese may regularly move from Denmark to south-western Norway, especially in mild winters (Jesper Madsen, personal communication in Molværsmyr *et al.* (2020)). Pink-footed geese breeding in Iceland or eastern Greenland winter in the United Kingdom (10). However, a small number of pink-footed geese from these populations are occasionally found in Southern Norway (7, 11).

A seroprevalence of 47% to avian influenza A virus was found in pink-footed geese sampled during the spring roost in Central Norway (Svalbard breeding population) between 2016–2018 (12). Of the seropositive birds, 3% (12/427) of the pink-footed geese had been exposed to the subtypes H5 and/or H7 (12). Considering that HPAI viruses found in nature have almost always contained the H5 or H7 hemagglutinin, one may hypothesize that HPAI has circulated among pink-footed geese visiting Norway in previous years. The retrospective detection of four positive Eurasian wigeons, eight days *before* the first pink-footed goose, indicates that HPAI virus has been circulating in the Jæren area for some time, and also emphasizes the uncertainty about which species may have introduced the virus to Norway.

From the analyses of data deriving from counts of geese in Jæren, as well as neck band observations and ordinary recoveries of ringed birds (10), some potential introduction routes of the HPAI virus to Norway are discussed below.

Wild birds migrating from Russia to the south-west during autumn have been proposed as a potential pathway for the introduction of HPAI virus to Europe (13), but it is difficult to assess whether this may also apply to Norway because of the lack of data on bird migration from Russia to Norway.

Similarly, we cannot rule out that geese from Iceland brought the virus to Norway during autumn migration. However, HPAI virus has not been detected in Iceland and this route of introduction is considered less likely.

A northward return migration of geese from their wintering sites in areas extending from Denmark to Belgium, to sites in Southern Norway, has recently been documented (10). Thus geese and other bird species may visit this region of Norway anytime during the winter season. Given that these birds have

been in areas with outbreaks of avian flu during the autumn of 2020, such as the west coast of Denmark and the Netherlands (4), they may have introduced HPAI virus to Southern Norway.

The Barnacle goose, like the pink-footed goose, also migrates through Norway and breeds on Svalbard. It was the species with the highest number of reported cases of HPAI virus of subtype H5N8 in Europe during the autumn of 2020 (4). Therefore, based on data by Molværsmyr et al. (10), we believe that HPAI virus of subtype H5N8 was most probably introduced by pink-footed geese and/or barnacle geese migrating to Norway from common night roosts along the west coast of Denmark, or from the Netherlands. However, more detailed studies of migratory routes of wild birds species, bird genetics (14) and molecular characterization of the H5N8 virus, are needed to answer this question. This is also illustrated by the four wigeons shot in mid-November, as it leaves an unanswered question of where and how these ducks were infected.

Already on November 19th 2020, prior to the first detection of HPAI, a request for increased vigilance to report sick or dead wild birds had been communicated to the public and bird watchers, through the national media and on the websites of the NFSA and NVI.

As an immediate response to the detection of HPAI in Norway, the NFSA introduced a high-risk area in line with Commission Implementing Decision (EU) 2018/1136 of August 10th 2018 on risk mitigation and reinforced biosecurity measures and early detection systems in relation to the risks posed by wild birds for the transmission of highly pathogenic avian influenza viruses to poultry. This included a housing order for poultry and birds kept in captivity in the coastal municipalities from Rogaland county in the southwest to the Swedish border in the southeast. As a result of multiple detections of HPAI in two counties in the two weeks following the initial detection (Table 1), the high-risk area was extended to Southern Norway south of Nordland county on December 7th 2020 (15). Poultry farmers were also informed of the risk from wild birds and encouraged to strengthen their biosecurity measures, and to immediately submit birds for AI analysis in the event of increased mortality, decrease in egg-production or decrease in intake of water and feed in their flocks.

On December 14th 2020, the NFSA issued regulation for an immediate ban of waterfowl hunting in Southern Norway until further notice (16). The main reason for introducing this ban was to avoid unnecessary disturbance to the birds and to prevent potentially infected waterfowl from moving out of infected areas. Hunters generally shoot healthy birds, but occasionally they may shoot sub-clinically infected birds or those early in the incubation period. Handling and processing these infected birds may pose a potential risk to poultry in areas with a high density of farms (Fig. 1).

Conclusion

HPAI virus has been detected for the first time in Norway, but the mode of introduction remains unclear. However, a northward migration of infected geese or gulls from Denmark or the Netherlands during the autumn of 2020, is currently our main hypothesis for the introduction of HPAI to Norway. More detailed studies of the migratory routes of wild birds species, bird genetics and molecular studies of H5N8 viruses,

are needed to answer this question. Finally, although HPAI of subtype H5N8 has been reported to have very low zoonotic potential, this is a reminder that HPAI with greater zoonotic potential in wild birds may pose a threat in the future. This underpins the importance of implementing a One Health strategy in handling avian influenza in Norway.

Methods

The NFSA is responsible for implementing the active surveillance programme for avian influenza (AI) in wild birds in Norway. The programme started in 2005 and is based on molecular (PCR) screening of cloacal and oropharyngeal swabs from healthy birds shot during the hunting season (5). Directly after sampling, swabs are placed in virus transport medium and mailed overnight to the NVI in Oslo. Samples are either processed immediately or frozen at -70°C upon arrival.

In addition, dead birds considered to be high risk species for HAPI (geese, ducks and gulls) are sampled in the field and submitted directly to NVI for PCR analysis (5).

Declarations

- **Ethics approval and consent to participate:**

Not applicable.

- **Consent for publication:**

Not applicable.

- **Availability of data and materials:**

Source data can be provided on request.

- **Competing interests:**

The authors declare that they have no competing interests.

- **Funding:**

No funding received.

- **Authors' contributions:**

KM initiated the study and drafted the manuscript. TM and BG provided laboratory data and drafted the manuscript. SG provided data from the index case. AF provided data on bird migration and drafted the

text on geese. OHT provided data and opinion from the Norwegian Food Safety Authority. JÅ provided the table. KRD provided the map. HJJ and CdN contributed significantly to the manuscript revision. GR contributed significantly to the study's design. All authors read, commented on, and approved the final manuscript.

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• Availability of data and materials:

The datasets generated, used and analysed during the current study are available from the corresponding author on reasonable request.

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Table

Due to technical limitations, table 1 is only available as a download in the Supplemental Files section.

Figures

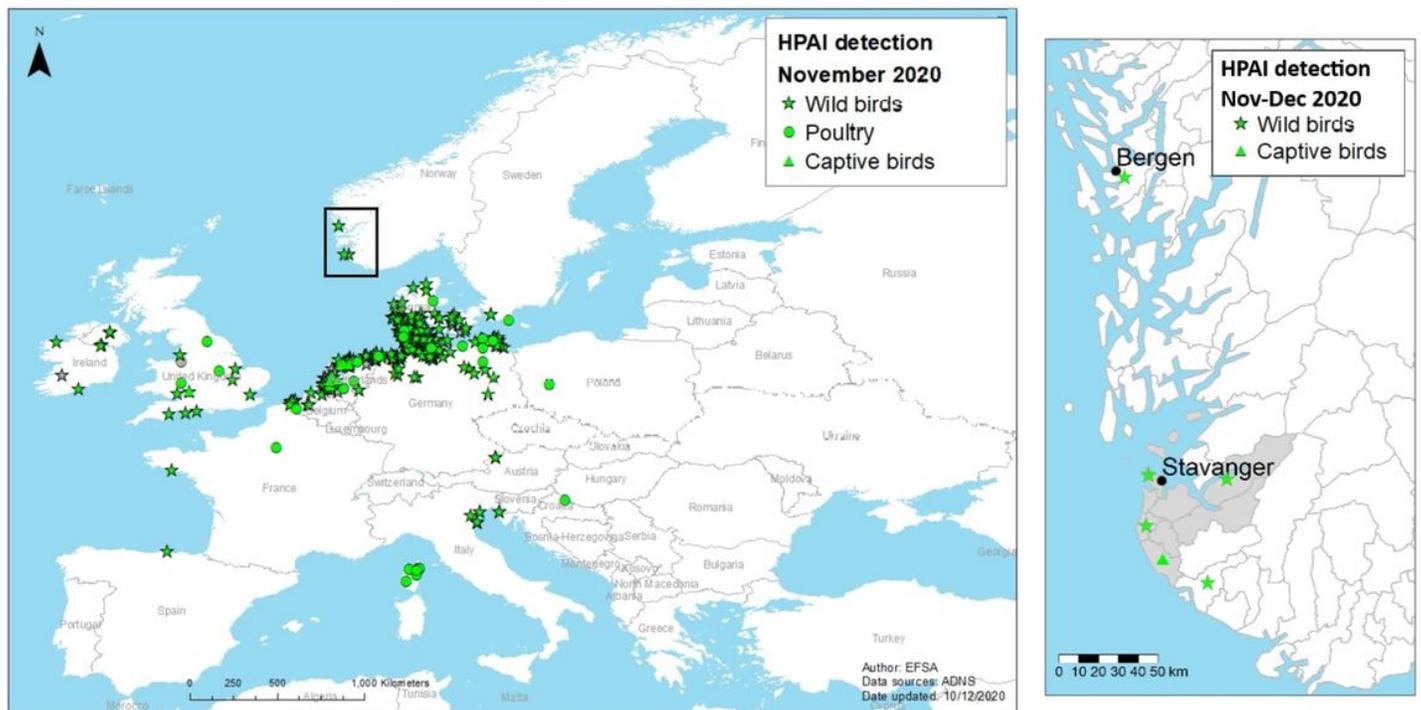


Figure 1

Left panel. Detections of Influenza A(H5N8) virus reported in wild birds (stars), poultry (circles), and captive birds (triangles), by EU/EEA countries in November 2020 (n=520). The black square shows the region of south Norway. Left panel reprinted with permission from EFSA (original in <https://doi.org/10.2903/j.efsa.2020.6379>). Right panel. HPAI detections in wild and captive birds in Southern Norway for November and December 2020. Black dots show the cities of Bergen and Sandnes. Grey shading highlights the municipalities that are in the traditional district of Jæren in Rogaland county. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

Supplementary Files

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- [Table1.xlsx](#)