Department
for Environment
Food & Rural Affairs

Rapid risk Assessment for the derogation of avian influenza control measures (H5N1 in wild birds in Fair Isle).

11 August 2021

Situation as at 11 August 2021

This publication is available at www.gov.uk/government/publications
Any enquiries regarding this publication should be sent to: IADM@apha.gov.uk
www.gov.uk/defra

Contents

Rapid Risk Assessment for the derogation of avian influenza control measures (H5N1 in wild birds in Fair Isle).

Date: 11/08/2021
Authors: Paul Gale, James Aegerter, Lévon Stephan, Ashley Banyard, Lauren Perrin and Ian Brown.
Peer reviewed: Harriet Auty, Lucy Gilbert.

Summary

Currently (10 August 2021), the risk of introduction of highly pathogenic avian influenza (HPAI) H5 infection in poultry in the UK is LOW with medium uncertainty for sub-optimal biosecurity and low uncertainty with stringent biosecurity. While the risk across the UK of HPAI infection in wild birds is currently LOW, this represents an average, and there will be spatial variation with localised foci of infection. It should be noted that LOW is defined as "rare, but does occur" and therefore sporadic outbreaks in wild birds are to be expected particularly given the increased incidence during the winter/spring from last season's unprecedented HPAI H5 epizootic making the likelihood of sporadic cases higher in a long tail through the summer months.

Three great skua (*Stercorarius skua*) carcases found on Fair Isle (Shetland, Scotland) on 20th July 2021, have tested positive for HPAIV H5 with one testing positive following virus isolation for H5N1.A rapid qualitative risk assessment is presented here to support considering whether this finding in wild birds on Fair Isle warrants a derogation from applying restriction zones. This risk assessment assumes that the HPAI H5N1 is the contemporary 'European' strain of HPAI H5N1, which has previously been detected in rooks (*Corvus frugilegus*) in Scotland, wild birds in England and game birds in Scotland.

This rapid risk assessment takes into account the unique geographical and ecological considerations of great skuas on Fair Isle. Firstly, Fair Isle is a small island between Orkney and Shetland. It is 4.8 km x 2.4 km. There is no record of any poultry within 10km of the map reference for the wild birds on Fair Isle although there are backyard poultry, including chickens. Secondly, great skuas are seabirds, only visiting Fair Isle during the spring and summer to breed. In addition to eating fish and live wild seabirds, they also steal food from other seabirds, mainly northern gannets (*Morus bassanus*) which is known as kleptoparasitism, during which there may be direct contact between the skua and the live seabird, which generally escapes, and which therefore could become infected. It should be emphasised that great skuas are not like gull species and should more be viewed like birds of prey in terms of feeding although they are not solitary and they breed on Scottish islands including Fair Isle in extended but well defined localised colonies. They are seabirds but, unlike gulls, great skuas do not visit poultry premises, except under exceptional and very rare circumstance for example when they are blown inland by bad weather (wrecks) during autumn migration.

It is shown here that the risk of HPAI H5N1 from great skuas at the breeding colony to commercial poultry in the potential 1 km, 3 km and 10 km zones is NEGLIGIBLE (low uncertainty) because there are no commercial poultry within 10 km of the great skuas' breeding colony. The risk to commercial poultry in the "free area" outside the 10 km zone is VERY LOW, reflecting not only the very low probability that great skuas fly inland to visit commercial poultry premises but also the large distances from the breeding colony on Fair Isle to the nearest mainland. The uncertainty is low reflecting the wealth of information

from ringing studies on great skua migration patterns and the species' preference for pelagic habitat. The risk to commercial poultry from great skuas is therefore lower than that to commercial poultry across the UK in general (currently 10 Aug 2021, LOW). The risk to non-commercial backyard poultry in the potential 1 km and free area (>10 km) zones from the great skuas is assessed to be LOW (medium uncertainty) again reflecting the low probability of skuas flying inland (except on Fair Isle itself) but noting that in very rare circumstances great skuas have attacked poultry. It should be emphasized that backyard poultry on Fair Isle do not pose an onward disease risk. The risk to backyard poultry is NEGLIGIBLE in the 3km and 10 km zones where there is just sea. The risk to wild birds through kleptoparasitism by great skuas is assessed to be MEDIUM (occurs regularly) with medium uncertainty in the 1 km and 3 km zones but LOW at 10 km and in the free area. The risk to other seabirds, including other great skuas, on Fair Isle (within the 3 km zone) is assessed to be MEDIUM (occurs regularly) with low uncertainty. This risk falls to LOW outside the 3 km zone although this may be an over-estimate because the HPAIV H5N1 strain adversely affects great skuas with many apparently succumbing to clinical disease with mortalities being seen. Therefore, infected birds may not be capable of flying long distances, hence containing direct transmission of disease to other wild birds to Fair Isle itself.

Introduction

In total, three great skua (*Stercorarius skua*) carcases found on Fair Isle (Shetland, Scotland) on 20th July 2021, have tested positive for HPAIV H5 with one testing positive following virus isolation for H5N1. At least 65 dead great skuas have been found on Fair Isle since the first reports on the 10 July 2021. This finding possibly represents a new species of bird in HPAI H5 epizootics and this is a new location in the current (2020/21) HPAI H5 epizootic.

In relation to considering whether the finding in wild birds on Fair Isle warrants a derogation from applying restriction zones, a rapid qualitative risk assessment is presented here. This risk assessment assumes that the HPAI H5N1 is the contemporary 'European' strain of HPAI H5N1, which has previously been detected in rooks (*Corvus frugilegus*) in Scotland, wild birds in England and game birds in Scotland. The H5N1 genome from one of the skuas has been sequenced. The HA fragment shares high sequence identity (>99%) with the Glenrothes pheasant report case (AIV2021_03), the chicken report case from England (AIV2020_12) and the H5N1 wild bird sequences detected over the 20/21 winter period. As such, the HA gene is the same as that previously reported for H5N1 report cases namely that it is the **European H5N1** which clusters with the Eurasian H5Nx sequences from 2020/21 (H5N8; H5N5) and belong to the same sub-family or clade. The 2020 incursion viruses belong to clade 2.3.4.4b which are distinct from recent and historical H5N1 HA sequences (which belong to different clades with greater public health risk) obtained from south-east Asia. Furthermore, all eight gene segments are very closely related to those of contemporary UK viruses supporting the likelihood of locally acquired exposure/infection. Public Health England has confirmed that the risk to public health is very low (H5N5, H5N1) to low (H5N8) for the three HPAI strains detected and characterised to date in GB.

This rapid risk assessment takes into account the unique geographical and ecological considerations of great skuas on Fair Isle. Firstly, Fair Isle is a small island between Orkney and Shetland. It is 4.8 km x 2.4 km. There is no record of any poultry within 10km of the map reference for the wild birds on Fair Isle although there are backyard poultry, including chickens. Secondly, great skuas are seabirds, only visiting Fair Isle during the

spring and summer to breed. They typically feed on discards from fishing boats in Shetland and predate other birds (especially fulmars and puffins) and rabbits. However, they do steal food from other seabirds, mainly northern gannets (*Morus bassanus*) which is known as kleptoparasitism, during which there may be direct contact between the skua and the live seabird, which generally escapes, and which therefore could become infected. It should be emphasised that great skuas are not like gull species and should more be viewed like birds of prey in terms of being top predators (Church et al. 2019). Although Great skuas breed on Scottish islands including Fair Isle in extended but well defined localised colonies. They are seabirds but, unlike gulls, great skuas do not visit poultry premises, except under exceptional and very rare circumstance for example when they are blown inland by bad weather (wrecks) during autumn migration.

HPAI H5N1 in a wild bird on Fair Isle (July 2021)

- There was no known presence of HPAI H5N1 in the area in recent months, with the last confirmed report in Scotland involving three rook carcases around a rookery in Fife between the 5th and 13th April 2021.
- The great skuas concerned are migratory and are present on Fair Isle between April and September each year where they nest in a large extended colony on a hill side where the carcases were found. They are sea birds and the great skua populations in Scotland are known to winter off the coast of north-west Africa (Magnusdottir et al. 2011). It is possible the skuas were infected by predating/scavenging/eating diseased seabirds and waterfowl including ducks, geese and swans (and great skuas are known to attack greylag geese for example on Shetland) or from faecal contamination from infected waterfowl feeding in the same freshwater lagoons as used by the skuas to bathe. Great skuas regularly bathe very close together in large numbers (50+) at a favoured freshwater site (P Gale, personal observations).
- Southward movement of great skuas from breeding areas on Scottish islands starts as early as July, with immature birds departing first. They are followed in August by failed breeders and the first fledglings. Most chicks and adults have left by the end of September, although a few chicks may not fledge until October.
- There is currently no AIPZ and no housing order in the UK, so poultry and captive birds are able to be outside and free-ranging.
- No ban on hunting or wildfowling is considered necessary (risk assessment concerning this has been published), as it would not increase likelihood of spread.
- There is no record of any poultry within 10 km of the map reference for the wild birds in Fair Isle although there are known to be backyard poultry.
- Public Health England has confirmed that the risk to public health is very low (H5N5, H5N1), to low (H5N8), for the three HPAI strains detected and characterised to date in GB.

Risk question

Taking into account any geographical and ecological considerations of the infected bird species, what is the likelihood of spread from these wild bird findings, leading to exposure of commercial or non-commercial poultry premises, other captive birds or wild birds to HPAI H5Nx; within a 1 km, 3 km or 10 km zone of the wild bird finding, compared to the background level of risk outside the 10 km zone?

Hazard identification

The hazard is highly pathogenic avian influenza H5Nx virus.

HPAI H5 was reported widely in the EU and the UK during the autumn and winter of 2020/2021 with the last cases in wild birds in the UK in early April (three dead rooks in Fife) and the last outbreaks in poultry/captive birds in the UK at the end of March. The virus most commonly implicated was HPAI H5N8, belonging to clade 2.3.4.4B, is not identical to that detected widely in the UK and globally in 2016/2017. Other related H5 viruses, including HPAI H5N1, have also been detected in Europe, but less frequently and in lower numbers. Nevertheless, the species susceptibility and clinical signs are similar. Tissue tropism for the brain and gastro-intestinal tract is seen, as well as the respiratory tract. While birds may start to become infectious after just 24 hours, a latent period of 1-2 days is more likely (i.e. time between infection and shedding virus) and detection on a farm could be assumed as around 5-7 days based on mortality thresholds (Salvador et al. 2020).

Currently (August 2021) HPAI H5 is still detected sporadically in wild birds particularly in southern Scandinavia and countries surrounding the Baltic Sea. Cases starting since 1 July 2021 include northern eider ducks (*Somateria mollissima*) and unidentified geese in Norway and Sweden and herring gulls (*Larus argentatus*) and white-tailed eagle (*Haliaeetus albicilla*) in Finland and are indicative of sporadic low levels of localised infection. It is not known whether the virus is being maintained in these birds or whether they are exposed to residual infectivity in the environment. With such heavy infection pressure over the winter and into the spring, a small number of cases would be expected in a residual tail through the summer. HPAI H5N1 has been reported in eagle species in Finland (detected mid-May).

Other HPAI H5 viruses circulating in the Europe in the last few years (H5N1, H5N5 and H5N6) are the result of reassortment events between the HA gene of the H5N8 virus and European origin NA genes of LPAI viruses.

The recent EFSA assessment (EFSA et al., 2020) reports that the reassortant A(H5N1) virus identified in EU/EEA countries has acquired gene segments from low pathogenic viruses and is not related to A(H5N1) viruses causing human infections outside of Europe (e.g. clade 2.3.2.1c).

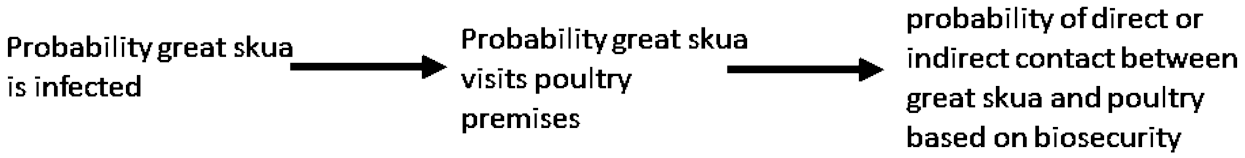
Terminology related to the assessed level of risk

For the purpose of the risk assessment, the following terminology will apply (OIE, 2004):

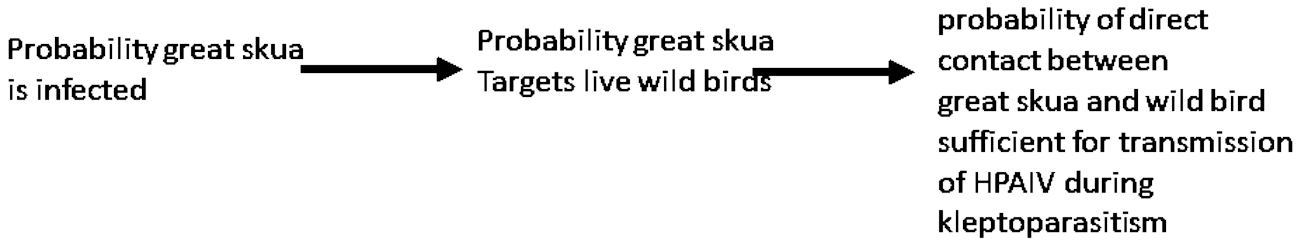
Negligible	So rare that it does not merit to be considered
Very low	Very rare but cannot be excluded
Low	Rare but does occur
Medium	Occurs regularly
High	Occurs often
Very high	Event occurs almost certainly

Risk pathway

The objective is to assess the additional risk to poultry and other wild birds from infected great skuas at the breeding colony on Fair Isle, which is additional to the background risk to poultry from other wild birds. The risk pathway for exposure of poultry is set out below.



Great skuas in addition to scavenging fish discards and predating other seabirds, wildfowl and rabbits, may steal food from other seabirds, mainly gannets in kleptoparasitism, during which there may be direct contact between the skua and the live seabird, which generally escapes, and which therefore could become infected. The risk pathway for exposure of live wild birds by kleptoparasitism is set out below.



Ecological considerations

Feeding

Skua species are best known to most birdwatchers as pirates and predators, but in fact they display a remarkable diversity of feeding methods, from traditional kleptoparasitism (stealing food from other seabirds) to predation on rabbits, seabird adults, eggs or chicks, passerines, waders and game birds of the tundra, and scavenging dead mammals or birds (Furness 1987, Church et al. 2019). Furness (1987) cites an example of a half-grown great skua regurgitating an entire arctic skua chick. The diet of great skuas in the North Sea has changed markedly from the 1970s to the 2010s from sandeels to live seabirds as the sandeels became virtually absent from the 1980s onwards (Church et al 2019) with increasing cannibalism of each other's chicks. The main feeding method of great skuas in Shetland/Orkney is discards from fishing boats. Although discards have been officially banned since 2019, skuas still feed mainly on fish (which in 2017 accounted for >60% of their diet (Church et al 2019)) via escapes from nets, presumed continuing illegal discarding, and stealing from gannets (kleptoparasitism). The proportion of their diet that is other birds and rabbits has increased significantly since the fishery discard ban (L. Gilbert unpublished data). When a great skua finds a dead seabird at sea it will attempt to defend it from other birds, although a second great skua may be tolerated as they work together to tear the corpse apart. During the autumn and on migration, birds generally feed at coastal or offshore sites on the way, often scavenging from fish boats a few kilometres from the coast. Indeed, they may be far enough out to sea that bird-watchers on the coast of Northumberland and Durham see very few compared to fishermen from fishing boats based in Sunderland. In fact, great skuas have an aversion to coasts during migration (Furness 1987).

Great skua migration patterns

Great skua migration patterns are well known because of some 1,500 recoveries of birds ringed as chicks in the northern isles of Scotland (Furness 1987). For example, great skuas ringed as chicks on Foula, Shetland, have been found on Fair Isle, England, Algeria, Morocco, Malta, USSR, Switzerland, Spain, Madeira, Guyana, France and Greenland. Virtually all British great skuas migrate south down the coast of Europe, with very few heading to North America. Southward movement of great skuas from breeding areas starts as early as July, with immature birds departing first. They are followed in August by failed breeders and the first fledglings. Most chicks and adults have left by the end of September, although a few chicks may not fledge until October.

During autumn, some great skua chicks move rapidly south with a few recovered over 3,000 km from Foula by the end of August in the year in which they hatched. Others may be recovered in Shetland as late as December. Strong winds and bad weather may cause "wrecks" when large numbers are driven over the coast of Europe by bad weather and may be recovered far into central Europe. One example cited by Furness (1987) was a young great skua rescued from a central reservation of a motorway in West Germany in October of its first year. Another inland recovery was a young great skua shot while attacking chickens in the yard of a farmhouse in West Germany (Furness 1987).

Geographical consideration

Fair Isle is a small remote island between Orkney and Shetland. It is roughly equidistant from Sumburgh Head, some 38 km (24 mi) to the northeast on the Mainland of Shetland and North Ronaldsay, Orkney, some 43 km (27 mi) to the southwest. It is 4.8 km x 2.4 km. Previously in the rapid risk assessment for rooks in Fife, the inverse square law was used to estimate the probability of rooks being infected as a function of the distance from the rookery. That was on land in Fife with extensive fields. It is unlikely that the great skuas restrict themselves to Fair Isle (or indeed limit their flights to around its coastline searching for food). This is because great skuas on Shetland feed on fish (discards from fishing boats, kleptoparasitised from gannets see above), other seabirds and therefore fly out to sea. The skuas also migrate south from Fair Isle between July and September dispersing around the coast of the UK. It is concluded that the inverse square law approach is appropriate even though some of the 1 km and much of the 3 km zones are over the sea and not on land.

Qualitative risk assessment for poultry

Probability wild bird/great skua is infected

The route(s) of transmission to the skuas on Fair Isle is not known but could feasibly occur through scavenging/eating infected dead/live seabirds on Fair Isle itself or in some other part of Scotland or even the Baltic Sea. They could also have been infected through environmental exposure during bathing at freshwater sites where previously infected waterbirds (greylag geese or whooper swans) on neighbouring Shetland or on Fair Isle itself could have been feeding. Greylag geese and a few whooper swans along with other waterbird species breed on Mainland Shetland, for example. It is assumed the skuas in the 1 km zone on Fair Isle have a high probability of carrying infection. This would include those at the breeding colony.

The risk of HPAI H5 in wild birds across UK is currently (10 August 2021) LOW, which is defined as “rare but does occur”. Therefore, there will be positive wild birds still present in parts of the UK, although none have been detected since April. The LOW level is in effect an average across the UK, and there will be spatial variation, with areas with no wild bird cases, and areas with foci of infection. Where there are foci of infection, local risk levels will be higher than the average. This is particularly so for HPAI H5Nx introduced into a colony-breeding species such as great skuas at a local site, and indeed three carcases tested positive for HPAIV H5 with many more carcases being found. It is therefore assumed that the risk for wild birds is HIGH in the 1 km zone (due to high prevalence in great skuas and perhaps other wild bird species, although scavenging gulls which may feed on the carcases are not common on Fair Isle, Parnaby 2016). Great skuas fly relatively long distances to search for food. By assuming the probability that skuas are infected is HIGH within the 1 km zone, this overcomes the need to consider mechanisms of transmission from skua-to-skua; which could include faecal-oral routes and direct contact through display or squabbling or consumption of carrion including great skua carcasses and increasingly cannibalism, especially through eating each other’s chicks.

However, this risk (represented conceptually as the number of infected skuas/wild birds per square kilometre) will rapidly drop with distance from the breeding colony, as the birds become dispersed and diluted with non-infected wild birds. It is assumed here that the risk drops according to the “inverse square law”; because the surface area of land (and surrounding sea) where the skuas could fly increases with the square of distance. Thus, at 3 km there would be ~10-fold drop in risk, and at 10 km there would be ~100-fold drop in risk. Thus, it is assumed that the probability that a great skua is infected is MEDIUM within the 3 km zone, but LOW within 10 km zone and in rest of UK. While there could be differences in local geography, particularly with extensive sea surrounding a small island like Fair Isle, the important point is that the risk of skuas being infected decreases from high to low as with a kernel. Skuas may fly many miles in search of fishing boat discards and the risk in the free area outside of 10 km from the infected skuas at the breeding colony is therefore assumed to be LOW (rather than very low or negligible if they stayed on Fair Isle all the time). This is the same risk level as that of the wild birds in the UK (currently 10 August 2021). Of course, if the infected skuas are unable to make long flights due to morbidity or even fly at all if severely affected by the virus, then the probability of infectivity outside Fair Isle itself will be greatly reduced.

Probability of great skuas visiting poultry premises

The probability of a great skua visiting a commercial poultry premises would be LOW or even VERY LOW. This is because great skuas typically feed and/or migrate several kilometres out to sea, and only rarely come inland (except to breed). That is not to say the occasional great skua does not land at coastal sites for example on shingle beaches during migration (P Gale personal observations). It may be those individual birds that are not well tend to land at coastal sites during migration while the fitter birds keep out to sea. It appears that those great skuas infected with HPAIV H5N1 do show clinical signs and morbidity such that flying ability is impaired. Thus, infected birds would be even less likely to venture inland where poultry premises would be located. Great skuas would not be interested in poultry feed but would go near poultry if they happened to spot opportunistically a chicken to kill or a dead chicken to scavenge. There is the single example (see above) of a young great skua actually attacking chickens at a farm in West Germany. This could happen with backyard birds. However, such events are extremely rare and most great skuas feed several kilometres out to sea during the autumn migration. Only after extreme bad weather when seabirds are blown inland (so called wrecks) would a great skua be likely to fly over farmland, where if starving could attack live poultry as a

last resort. It is assumed the probability of a great skua visiting a non-commercial backyard premises is LOW. On Fair Isle itself, great skuas would be unlikely to attack poultry because of the abundance of other food sources that are easier to predate and safer, being further away from human habitation. Clearly an HPAIV-infected great skua attacking live poultry would greatly increase the risk of exposure of the poultry to the virus, and even the skua just scavenging the carcase could leave HPAIV H5 infectivity in faeces in the vicinity. Unlike corvids, for example, which may be interested in chicken feed, a great skua would not attempt to put its beak through gaps in chicken wire, for example. It is assumed the probability of a great skua's visiting a commercial poultry premises is VERY LOW but LOW for a non-commercial backyard premises.

Probability of direct or indirect contact between infected great skua and poultry based on biosecurity

This can be interpreted as the probability that the virus gets through biosecurity at poultry establishment given the skua has made a visit.

The reduction in probability of exposure of poultry with sub-optimal biosecurity is 4-fold (EFSA 2017) i.e. MEDIUM probability of poultry exposure, given a skua visits the poultry premises.

The reduction in probability of exposure of poultry with stringent biosecurity is 44-fold (EFSA 2017) i.e. LOW probability of poultry exposure, given a skua visits the poultry premises.

It is assumed that commercial free-range is the same as with sub-optimal biosecurity for this rapid risk assessment, i.e. commercial free range with biosecurity does reduce the probability of bird contact by 4-fold (i.e. medium "probability of direct or indirect contact between an infected great skua and poultry").

In the case of non-commercial backyard poultry (which could be free-ranging), it is assumed that the probability of direct or indirect contact between the infected great skua and poultry, assuming an absence of biosecurity, is HIGH.

Exposure assessment to poultry

The risk of exposure of poultry on commercial premises within 1 km, 3km, 10 km and rest of UK is assessed to be VERY LOW for sub-optimal biosecurity (Table 1) and for stringent biosecurity (Table 2). This is because the probability that a great skua visits a poultry premises is very low. In the case of the great skua colony on Fair Isle, there are no commercial premises within 10 km. The risk of exposure to commercial poultry within 10 km of the colony is therefore NEGLIGIBLE with low uncertainty irrespective of the degree of biosecurity. The risk of exposure to poultry nearest commercial premises in the free area is VERY LOW, again with low uncertainty because the probability of a great skua being infected at such distances from the breeding colony is LOW in addition to the VERY LOW probability it would visit a commercial poultry premises. There is even less uncertainty in this VERY LOW exposure risk for commercial poultry with stringent biosecurity (Table 2) and it would actually be nearer NEGLIGIBLE.

The risk of exposure of poultry on a backyard premises with limited biosecurity within 1 km, 3km, 10 km and rest of UK is assessed to be LOW (Table 1). This is because the probability that a great skua visits a backyard poultry premises is low. The uncertainty in

this is MEDIUM. The uncertainty is also compounded by a lack of the information on the number of backyard premises on Fair Isle itself. Infection of the backyard poultry by great skuas through avian bridging species is unlikely because the common passerine bridging species such as common starling (*Sturnus vulgaris*), twite (*Linaria flavirostris*) and rock dove (*Columba livia*) which may contact backyard poultry are unlikely to come in contact with great skuas. Water bird bridging species such as ducks and geese that could be infected by great skuas while bathing are not common on Fair Isle in the summer and can be ignored. Unlike on the mainland UK, gull species tend to be migrants to Fair Isle (Parnaby 2016). Of the gull species breeding on Fair Isle, black-legged kittiwakes (*Rissa tridactyla*) breed in moderate numbers on the cliffs and feed on sandeels and do not mix with backyard poultry, while common gulls (*Larus canus*) are present in very low numbers (Shaw et al 2002, Parnaby 2016).

Table 1: Risk of exposure to commercial poultry premises with sub-optimal biosecurity, with HPAI H5Nx from great skuas in general (albeit dominated by great skuas from the infected breeding colony).

Distance from infected breeding colony	1km	3 km	10 km	Free area
Probability great skua is infected	High	Medium	Low	Low
Probability great skua visits poultry premises	Very low	Very low	Very low	Very low
Probability commercial poultry present	Negligible	Negligible	Negligible	Very high
Probability of direct or indirect contact between infected great skua and poultry, assuming sub-optimal biosecurity	Medium	Medium	Medium	Medium
Overall predicted risk of exposure to poultry from great skuas*	Negligible	Negligible	Negligible	Very low
Current (6 August 2021) background risk to poultry in GB from all birds	LOW	LOW	LOW	LOW
*Calculated as lowest probability in the column according to matrix of Gale et al. (2009).				

Table 2: Risk of exposure to commercial poultry premises with stringent biosecurity, with HPAI H5Nx from great skua in general (albeit dominated by skuas from the infected breeding colony).

Distance from infected breeding colony	1 km	3 km	10 km	Free area
Probability great skua is infected	High	Medium	Low	Low
Probability great skua visits poultry premises	Very low	Very low	Very low	Very low
Probability commercial poultry present	Negligible	Negligible	Negligible	Very high
Probability of direct or indirect contact between infected great skua and poultry, assuming stringent biosecurity	Low	Low	Low	Low
Overall predicted risk of exposure to poultry from great skuas*	Negligible	Negligible	Negligible	Very low
Current (6 August 2021) background risk to poultry in GB from all birds	LOW	LOW	LOW	LOW
*Calculated as lowest probability in the column according to matrix of Gale et al. (2009).				

Table 3: Risk of exposure to non-commercial backyard poultry premises with limited biosecurity, with HPAI H5Nx from great skuas in general (albeit dominated by great skuas from the infected breeding colony).

Distance from infected breeding colony	1km	3 km	10 km	Free area
Probability great skua is infected	High	Medium	Low	Low
Probability great skua visits backyard poultry premises	Low	Low	Low	Low
Probability non-commercial backyard poultry present	Very high	Negligible	Negligible	Very high
Probability of direct or indirect contact between infected great skua and poultry, assuming no biosecurity	High	High	High	High
Overall predicted risk of exposure to poultry from great skuas*	Low	Negligible	Negligible	Low
Current (6 August 2021) background risk to poultry in GB from all birds	LOW	LOW	LOW	LOW
*Calculated as lowest probability in the column according to matrix of Gale et al. (2009).				

Qualitative risk assessment for wild birds

Probability great skua targets live wild birds for food

Based on the ecological considerations above, it is concluded that the probability of great skuas targeting live wild birds during the breeding season on Shetland is very high (Church et al. 2019). While seabird carcasses may be scavenged, they are already dead, and hence cannot be infected by the infected skua itself. Similarly freshly killed live birds (puffins and fulmars on Shetland) which although a larger part of the skua's diet, are dead end hosts for any virus and are not relevant here. For the purpose of the risk assessment here, kleptoparasitism is the wild bird contact of interest because the target bird survives and could potentially become infected from the contact with the skua. Although fishing boat discards and other seabirds are the main food sources, great skuas do regularly resort to kleptoparasitism from other seabirds for which the probability is assessed to be **medium** (occurs regularly) with low uncertainty.

Probability of direct contact between great skua and live wild bird sufficient for transmission of HPAIV during kleptoparasitism

Most kleptoparasitism by skuas involves aerial interception or chases. In some cases, the skua flies faster than its victim as with great skuas robbing gannets. The victim is usually harried for a period of several seconds or even minutes until it gives up its food, or the skua gives up the chase. Such chases may result in physical attack and in convoluted aerobactic manoeuvres. When the victim flies faster than the skua, the skua attacks head-on causing the victim to brake, or they attack from above often with surprise. The great skua most often grabs the gannet's wing or tail to pitch it into the sea (Furness 1987). The gannet may then regurgitate its food before flying off unmolested, although gannets often fight back generally without success. It is therefore concluded the probability of direct contact between great skua and live wild birds during kleptoparasitism is **medium** particularly since a gannet would preen its feathers where the skua had pecked it. It is not clear whether individual skuas infected with HPAIV would be capable of the high speed chases required for kleptoparasitism, and the risk assessment here is therefore worst case.

Exposure assessment to wild birds

The probability of exposure to wild birds through kleptoparasitism by great skuas is estimated to be MEDIUM within 3 km of the breeding colony, but LOW at 10 km and beyond. (Table 4). There is medium uncertainty because it is not clear whether infected great skuas would be sufficiently fit to chase other birds. Furthermore, great skuas are aggressive, gregarious birds and may have contacts with other species and each other during disputes, feeding or bathing. They breed in extended colonies, eat each other's chicks and bathe together in close contact. The overall probability of infecting other birds including other great skuas within the 3 km zone is assessed to be MEDIUM (occurs regularly) overall with low uncertainty. This risk falls to LOW in the 10 km zone and the free area although this may be a worst case because infected great skuas may not be able to fly long distances.

Table 4: Risk of exposure to wild birds with HPAI H5Nx through kleptoparasitism by great skuas from the infected colony.

Distance from infected breeding colony	1km	3 km	10 km	Free area
Probability great skua is infected	High	Medium	Low	Low
Probability great skuas targets live wild birds in kleptoparasitism	Medium	Medium	Medium	Medium
Probability of direct contact between great skua and live wild bird sufficient for transmission of HPAIV during kleptoparasitism	Medium	Medium	Medium	Medium
Overall predicted risk of exposure to wild birds from great skuas*	Medium	Medium	Low	Low
Current (6 August 2021) background risk of incursion of HPAI H5 in UK birds	LOW	LOW	LOW	LOW
*Calculated as lowest probability in the column according to matrix of Gale et al. (2009).				

Conclusions

1. The risk to commercial poultry from great skuas at the infected breeding colony in the potential 3 km and 10 km zones on Fair Isle is NEGLIGIBLE (with low uncertainty) because there are not any commercial poultry premises within 10 km of the great skua breeding colony. Even if commercial poultry were present in the potential 3 km and 10 km zones, the risk of exposure would be VERY LOW, reflecting the VERY LOW probability that a great skua would visit commercial poultry premises. The risk to commercial poultry outside the 10 km zone in the "free area" is VERY LOW with low uncertainty and lower than the current (10 Aug 2021) risk of exposure to poultry across the UK in general (that is LOW with sub-optimal biosecurity or with stringent biosecurity). Thus, the additional risk posed by the infected skuas in the breeding colony to commercial poultry is lower than that posed by other birds in all zones. This is mainly because great skuas are seabirds and do not generally come inland where commercial poultry houses are located.
2. The risk to any non-commercial backyard poultry within the potential 1km zone from the great skuas is LOW (medium uncertainty), reflecting the rare possibility that a great skua might scavenge a backyard bird carcase or even attack backyard poultry. Similarly, the risk to non-commercial backyard poultry in the "free area" (>10 km) is LOW but negligible in the 3km and 10 km zones which are in the sea.
3. It should be noted that transmission of HPAI to and between great skuas has never been reported before and may be very different from that in ducks and waterfowl. The risk to wild birds through kleptoparasitism by great skuas is MEDIUM (medium uncertainty). Similarly, the overall risk of spread to other wild birds (mainly other seabirds but also other great skuas) on Fair Isle is assessed to be MEDIUM (low uncertainty).

References

Church, G, Furness, R, Tyler, G, Gilbert, L, Votier, S (2019) Change in the North Sea ecosystem from the 1970s to the 2010s: great skua diets reflect changing forage fish, seabirds, and fisheries. *ICES Journal of Marine Science* DOI: 10.1093/icesjms/fsy165.

EFSA Scientific Opinion on Avian Influenza. The EFSA Journal (2017) 1-233. https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2017.4991.

EFSA (European Food Safety Authority), ECDC (European Centre for Disease Prevention and Control), EURL (European Reference Laboratory for Avian Influenza), Adlhoch C, Fusaro A, Gonzales JL, Kuiken T, Marangon S, Niqueux É, Staubach C, Terregino C and Baldinelli F, (2020). Scientific report: Avian influenza overview August – December 2020. EFSA Journal 2020;18(12):6379, 57 pp. doi:10.2903/j.efsa.2020.6379

Furness, R.W. (1987) The Skuas. T&AD Poyser, England.

Gale, P., Brouwer, A., Ramnial, V., Kelly, L., Kosmider, R., Fooks, A.R. and Snary, E.L. (2009) Assessing the impact of climate change on vector-borne viruses in the EU through the elicitation of expert opinion. *Epidemiology and Infection* 138, 214-225.

Ellen Magnusdottir , Eliza H.K. Leat , Sophie Bourgeon , Hallvard Strøm , Aevar Petersen , Richard A. Phillips , Sveinn A. Hanssen , Jan O. Bustnes , Pall Hersteinsson & Robert W. Furness (2012) Wintering areas of Great Skuas Stercorariusskua breeding in Scotland, Iceland and Norway, Bird Study, 59:1, 1-9, DOI: 10.1080/00063657.2011.636798.

Parnaby (2016) Fair Isle Bird Observatory Report for 2016. (http://www.fairislebirdobs.co.uk/reports/annualreport2016.pdf)

SALVADOR, R., TANQUILUT, N., LAMPANG, K.N., CHAISOWWONG, W., PFEIFFER, D., PUNYAPORNWITHAYA, V. (2020) Identificaiton of high risk areas for the spread of Highly Pathogenic Avian Influenza in Central Luzon Philippines. Veterinary Sciences 107; doi:10.3390/vetsci7030107

Shaw, D.N., Holt, C.A., Maggs, H.E and De Pacio, d. (2002). Fair Isle Seabird Studies 2000. JNCC Report. (https://data.jncc.gov.uk/data/a26baf87-0e9d-4cd8-b3c3-b9e2af1fa882/JNCC-Report-332-FINAL-WEB.pdf).