Manitoba Agriculture, Food
and Rural Initiatives

Vulnerability Assessment

Avian Influenza
Introduction into Manitoba
Domestic Poultry and Swine

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SECTION 1 - Executive Summary

1.1 Clinical Disease in Animals

Influenza type A is a viral disease affecting many species of animals, including birds, pigs, people, horses, sea mammals, and most recently, dogs and cats. Influenza viruses are genetically unstable and mutations are common. These mutations may occur gradually or in some cases, dramatically, causing a shift in the pathogenicity (disease-causing ability) or adaptation to a new host species. In commercial poultry, the virus infects the respiratory and digestive tracts causing respiratory distress (difficult breathing) and in severe cases, sudden death. In commercial flocks infected with a highly pathogenic virus the death losses can be dramatic.

In mammalian species, influenza affects primarily the respiratory tract but it can spread to become a generalized systemic infection. In most cases, the infection causes high rates of morbidity (clinical illness) but relatively low mortality. However, when epidemics strike a susceptible population the mortality rates can be significant. The present concern over the H5N1 Asian strain of avian influenza virus is its demonstrated ability to cause illness and death in humans.

1.2 Risk from Wildlife - Evolution of Dangerous Strains

Many species of wild water birds can carry influenza viruses asymptomatically, but young of the year mallard ducks seem to harbour the virus most consistently. The classic route for an outbreak of highly pathogenic avian influenza in domestic poultry occurs when a low pathogenic strain of the virus jumps from wild waterfowl into dry land poultry, such as chickens or turkeys. The virus then cycles undetected in commercial flocks until it mutates into in a highly pathogenic strain that causes clinical illness.

Highly pathogenic strains commonly kill over 50% of the affected birds within 24 hours and are easily detected clinically. The length of time that low pathogenic virus can circulate undetected within commercial poultry is unpredictable. To date, the virus has become highly pathogenic only in large commercial flocks of chickens, turkeys and other gallinaceous birds with a flock size exceeding 10,000 individuals. The virus has not been documented to mutate into the deadly form in domesticated waterfowl or small poultry flocks.

Avian influenza virus shed in the feces of migratory waterfowl and shorebirds can survive for extended periods in untreated pond water. Confined commercial poultry and swine may be exposed to the virus if untreated water is drawn from such sources. Chlorination greatly reduces or eliminates the risk of introduction by that route.

1.3 Small Flocks

Small flocks are very unlikely to act as silent carriers of avian influenza. Winter in Manitoba provides a natural down time in which farms with small flocks are either depopulated, or the birds are housed indoors. Small flock owners wishing to reduce the risk of avian influenza infecting their birds can arrange to market their summer flocks prior to the beginning of the wild waterfowl migratory season. Alternatively, producers can house their birds during this time, when the risk of spread of avian influenza from wild waterfowl is highest. Small flocks in Manitoba are a minor risk to humans and commercial poultry.

1.4 Outdoor Goose Production

Domestic geese are highly resistant to low pathogenic forms of avian influenza. There is no evidence to date that the virus has ever mutated to the highly pathogenic form within a goose flock. If domestic geese are exposed to a highly pathogenic form, introduced from other poultry or wild waterfowl, some morbidity may occur. The most likely result of an introduction of Asian H5N1 avian influenza into a domestic goose flock would be a low level of sick and dead birds and a limited amount of shed of the virus. Increased clinical surveillance could be relied upon to detect suspicious outbreaks that should be investigated further.

Manitoba accounts for half of the commercial goose production in Canada. There are no known methods to raise commercial geese indoors. Confinement housing of ducks is possible and some Manitoba producers have raised small flocks of ducks indoors. A ban on outdoor production would effectively eliminate commercial goose production in Manitoba. Increased biosecurity recommendations for geese would include protection of the feed and water supplies from fecal contamination by wild birds, and fencing off ponds that are frequented by wild migratory ducks and geese.

1.5 Turkey Production

Manitoba turkey flocks are at a high risk to be the entry point for any new influenza virus. This is because many turkey flocks are allowed access to the outdoors and because infected turkeys usually exhibit milder clinical symptoms, compared to chickens. It should be noted that an exception to this pattern occurred in Italy in 2001 when a turkey-adapted strain caused significant mortality in commercial turkeys prior to mutating into a chicken pathogen.

Historically, although turkeys are far less populous than chickens, they are disproportionately more likely to be identified in new outbreaks of highly pathogenic avian influenza. Recently, Manitoba turkey breeding flocks have been clinically affected by swine-adapted H3N2 influenza despite widespread vaccination and high biosecurity protocols. Special attention should be paid to increasing clinical surveillance of turkey flocks and investigating reports of disease.

1.6 Chicken Production

Chicken production is segmented into meat and egg production, each with their associated parent breeding stock. Commercial chicken meat flocks live less than 45 days under total confinement and unless influenza is introduced through a breakdown in biosecurity, there is little opportunity for the disease to be maintained in this type of production system. Table egg laying chickens are also kept indoors under strict biosecurity protocols. However, these birds are longer lived so that if low pathogenic influenza virus is introduced, there is more opportunity for the virus to mutate into a highly pathogenic form. Highly pathogenic avian influenza causes a dramatic drop in egg production; therefore, normal egg production acts as a sensitive indicator of absence of infection. The initial flocks infected in the British Columbia 2004 outbreak were flocks maintained to nearly 2 years of age for the production of hatching eggs for the chicken meat industry. Increased mortality and a dramatic drop in egg production were the first signs of infection in these birds and the private veterinary practitioner was called in promptly to investigate.

1.7 Influenza A in Swine

Influenza infection of pigs does have some potential human health implications, although recent outbreaks of pig-adapted viruses have not been associated with human deaths. The movement of low pathogenic avian strains or the H5N1 Asian highly pathogenic strain of avian influenza from wild birds to pigs has not been associated with high mortality in pig populations in Asia. However, if Asian strain H5N1 were to be identified in the Manitoba swine complex, multiple repercussions could be expected, especially if there was associated human illness or death. These might include the closure of the US border to live swine and pork, worker refusal to enter swine buildings, extreme logistic problems in dealing with surplus animals and the public perception of danger.

1.8 Public Health

The current strain of Asian H5N1 virus transmits from poultry to people with difficulty and only under specific exposure conditions of very close contact. The human-poultry interaction in Manitoba is significantly different from that in other countries where poultry, pigs and people live in very close proximity. With the same land mass as Thailand, Manitoba has 1/60th the human population, 1/30th

the number of poultry and 1/1000th the number of flocks; therefore, the opportunity for transmission between poultry and humans is extremely low.

For the general public, the most noticeable impact of the emergence of Asian H5N1 avian influenza may be public alarm in relation to the very visible numbers of Canada Geese and other wild water birds in urban settings. If these birds are not displaying clinical signs, the risk to humans is likely to be very small. Nevertheless, it is prudent to use normal hygienic practices when exposed to wild birds or their droppings. Pets (such as dogs and cats) may be exposed to the virus if they swim in drainage ponds or if they hunt and consume sick birds.

Strategically, human-adapted influenza viruses currently circulating in swine are of a higher potential public health risk than are North American strains of waterfowl-associated avian influenza. Increased surveillance and investigation of respiratory disease outbreaks in swine might provide an early warning of influenza circulating within that population.

The present human health concern is rightly focused on the biological stability of the current epizootic strain of Asian H5N1. Should this virus become adapted to humans then all agricultural-based risks would become irrelevant.

1.9 Recommendations

Surveillance

- In cooperation with producers, veterinary practitioners and federal animal health partners, enhance the surveillance and field investigation capacity of the Provincial Veterinary Services. This would target investigations into clinical illnesses of commercial and backyard poultry flocks. The CVO of Manitoba is lead on the surveillance component of the federal-provincial Canadian Animal Health Surveillance Network. This affords the opportunity to pilot a novel surveillance system in Manitoba.

- Working with producers and their veterinarians, initiate a disease surveillance program specifically targeted to outdoor goose and outdoor turkey production.

- Work cooperatively with wildlife officials to actively investigate suspicious clinical disease and mortality in wild migratory birds.

Diagnostic Capacity

- Enhance laboratory surge capacity in viral diagnosis in veterinary services, especially for early detection of influenza viruses.

- Encourage laboratory sample submissions from commercial and backyard poultry flocks as a method of monitoring poultry diseases.

Response

- Implement provincial legislative and regulatory changes to permit the registry of food processing animals, especially commercial and backyard flocks, and swine operations.

- Work with producer organizations, the Manitoba Veterinary Medical Association, provincial and federal agencies to refine and test emergency disease response plans involving the poultry and swine industries.

- Put in place the necessary response tools such as GIS mapping, Incident Command Structures, and Emergency Operations Centres to deal with animal health emergencies.

Best Practices

- Educate small flock owners to either market the birds before the start of the "fall bird migration season" or to keep their birds from contact with migratory waterfowl during this period. Education and voluntary compliance are likely to be highly effective given the intense public interest in the matter.

- Prevent domestic waterfowl and poultry from accessing open water frequented by migratory waterfowl.

- Guard water and feed sources for domestic poultry and swine from fecal contamination from wild birds. Chlorinate water drawn from ponds and dugouts.

- Separate domestic species. Wherever possible, raise only one species of poultry on a farm, and do not raise poultry where swine are housed.

- On farms where multiple species are kept, implement and enforce strict biosecurity practices between barns. Encourage commercial producers to enroll in on-farm food safety (quality assurance) programs.

- Promote rapid reporting and investigation of suspicious illness in domestic poultry and swine.

- Promote public education to emphasize prudent hygienic practices when in contact with waterfowl or their droppings, especially during the fall migration. Prevent pets from contacting or consuming dead or sick birds.

Inter-Agency Cooperation

- Work cooperatively with producers, veterinary practitioners and other provincial and federal agencies to prepare for an influenza outbreak in poultry, pigs or people. Through the federal-provincial Canadian Animal Health Surveillance Network cooperate with other provinces and CFIA to increase surveillance and diagnostic capacity for influenza in all species.

1.10 Conclusion

- Avian influenza (H5N1 southeast Asian strain) has spread throughout Asia into Europe and Africa, probably through the migration of wild waterfowl and shorebirds. It is very likely that this strain will spread to North America by the same route.

- This strain of virus has demonstrated a high degree of pathogenicity in domestic poultry and, to a lesser degree, in its natural host, migratory waterfowl. Over 90 people who have had very close contact with infected poultry have died worldwide, but it is unknown how many hundreds of thousands, or even millions have been exposed to the virus and have not developed any clinical illness.

- The risk of such close contact in Manitoba is very small indeed. Our commercial flock production practices are very different from those in southeast Asia and our producers implement biosecurity measures to protect domestic poultry from coming into contact with wild birds. On those farms that keep birds outdoors (geese and turkeys), extra precautions to protect feed and water supplies, and to fence off ponds will greatly reduce the opportunity for spread of the virus from wild to domestic birds. Although swine have not yet been reported to be a significant part of the epidemiology of the disease, they remain as a potentially vulnerable sector in Manitoba. Similar biosecurity measures are recommended as a wise precaution in swine herds.

SECTION 2 - Introduction

2.1 Summary Points:

- The Influenza A family of viruses are genetically unstable and mutate continually.

- There are two major systems for classifying influenza A viruses:
  a) Antigenic
  There are 16 major H-types and nine major N types leading to 144 possible H-N combinations.
  b) Pathogenic
  Highly pathogenic viruses cause severe clinical disease in chickens (but not necessarily in other species).
  Low pathogenic strains cause mild or inapparent clinical infection.

- Influenza A viruses are commonly carried asymptomatically by wild waterfowl and shore birds. Ducks are the most common carriers.

- Other species (domestic poultry, pigs, humans) can also be infected. If domestic poultry become infected with highly pathogenic influenza, dramatic losses can occur.

- It appears that outbreaks of highly pathogenic avian influenza are becoming more common worldwide.

- The southeast Asian strain of H5N1 influenza has spread throughout Asia and now Europe and Africa. It has the potential to cause disease in migratory waterfowl, domestic poultry and humans. This is an unprecedented situation, not previously observed in other outbreaks.

- It is important to rapidly identify and promptly eradicate outbreaks of H5/H7 or highly pathogenic strains of influenza.

- At present, vaccination is not likely to be an effective disease control measure. Rapid genetic mutations of field virus make it difficult to develop an effective vaccine.

- It is important to keep domestic poultry and waterfowl separated from wild migratory waterfowl. The virus can survive in feces or contaminated pond water.

2.2 Infectious Agent

Virus Family: Orthomyxoviridae
Genus: Influenzavirus A

Types of virus

Avian Influenza (AI) is caused by type A strains of the influenza virus. All type A influenza viruses are not fixed genetically and are well adapted to elude host defenses. Strains of the virus can be either low pathogenic or high pathogenic depending on their genotype. Pathogenicity refers to ability to cause disease in chickens, not necessarily in other species. High pathogenic strains (HPAI) can cause severe disease in poultry. Low pathogenic strains (LPAI) result in milder, less significant disease. LPAI strains also have the ability to mutate to HPAI forms.

The type A influenza viruses are further divided into subtypes based on the antigenic relationships of surface glycoproteins (Haemagglutinin – HA, and Neuraminidase – NA). At present there are 16 HA subtypes (H1-16) and nine NA subtypes (N1-9). Each virus strain has one H and one N in any combination. To date, all strains highly pathogenic to poultry have been type A of subtypes H5 and H7. To date, all type A strains causing disease in people have been of human adapted subtypes H1, H2, H3, and avian origin subtypes H5, H7, and H9.

Animal reservoirs

Waterfowl, Anseriformes (ducks, geese, and swans) and Charadriiformes (plover-like birds) comprise several hundreds of species. Wild ducks and geese are the main known natural reservoir of avian influenza viruses and ducks are one of the birds most resistant to clinical disease. Mallard ducks (*Anas platyrhynchos)* have been shown to excrete virus for up to 17 days following infection. A number of mammal species are also susceptible to species-adapted strains of Influenza-A including humans, pigs, horses, dogs and marine mammals. Other species such as ferrets, mice and cats can become naturally infected with avian strains as dead-end hosts.

Signs of disease in poultry with HPAI

Typically the disease in poultry presents suddenly with affected birds showing oedema (swelling) of the head, cyanosis (purple/blue discolouration) of the comb and wattles, dullness, lack of appetite, respiratory distress, diarrhea and drop in egg production. Birds may die without any signs of disease being apparent. Influenza therefore should be considered in the differential diagnosis of any significant unexplained mortality. There can be considerable variation in the clinical picture and severity of the disease.

Aquatic birds are the primary reservoir of influenza A viruses. Low pathogenic strains may cross the species barrier, infecting non-natural hosts such as land-based poultry, including chickens, turkeys, quail, guinea fowl, chukar etc., without causing overt clinical signs. However, for reasons that are still poorly understood, influenza virus strains circulating in land-based poultry can mutate into highly pathogenic strains and cause significant morbidity and mortality. The molecular mechanisms that lead to the emergence of influenza viruses in land-based poultry are moderately well understood with the exception of predicting the temporal sequence of emergence. Highly pathogenic strains have also been identified that have originated 'in toto' from wild waterfowl origin (Campitelli et al 2004).

Canadian migratory ducks carry many strains of influenza A (Hatchette et al 2004, Hanson et al 2003), however all scientific evidence to date indicates that Influenza-A does not mutate into highly pathogenic forms if it is contained within the wild bird ecosystem (Widjaja et al 2004).

Furthermore, highly pathogenic avian influenza may pose a threat to public health, as evidenced by the direct transmission of H5 and H7 influenza A viruses from domestic poultry to humans in Asia (Webster et al 2005) and the Netherlands (Koopmans et al 2004, Du Ry van Beest Holle et al 2005), respectively.

Theoretically, viruses of all HA subtypes have the potential to cause disease in poultry. The extremely virulent virus strains responsible for highly pathogenic avian influenza (HPAI), result in mortality that may be as high as 100%. These viruses have been restricted to subtypes H5 and H7, although not all viruses of these subtypes are necessarily HPAI (Webster et al, 1992). Viruses with any other HA-subtype cause a mild, primarily respiratory disease in poultry, which may be exacerbated by other infections or environmental conditions. Unlike other HA subtypes, the highly virulent H5 and H7 viruses possess multiple basic amino acids at the cleavage site of the HA which is a marker for pathogenicity.

The incidence of emergence of outbreaks of HPAI appears to be increasing. Between 1959 and 1999, 21 primary outbreaks of HPAI in poultry have been reported world-wide with 12 since 2000. Influenza viruses have been shown to infect all types of domestic or captive birds throughout the world. The probability of primary infections is proportional to the frequency of contact with feral birds or fecal droppings. Provided that the virus can be transmitted horizontally in poultry, secondary virus spread is usually associated with human involvement, probably by transferring infective feces to susceptible birds.

Although China is a major poultry producer, official documentation of pathogenic influenza emergence has been rare in the past 50 years. Between May and August 2005, outbreaks of HPAI (H5N1) virus have been reported in domestic poultry in China, the southern part of Russia and north-east Kazakhstan. China also reported that H5N1 virus had been isolated from dead wild migratory water birds in May 2005. Mongolia reported that H5 virus had been isolated from a few dead wild migratory water birds in the northern part of the country close to the Russian border in August 2005. Outbreaks have also obscured in the countries of Turkey, Croatia and Romania in October And Italy and Nigeria in January 2006.

2.3 Historic Summary

Up to the end of 2003, highly pathogenic avian influenza (HPAI) has been considered a rare disease. Between 1959 and 2004 when , only 24 outbreaks had been reported worldwide. The majority occurred in Europe and the Americas. Of the total, only 5 resulted in significant spread to numerous farms, and only one was associated with spread to other countries (Table 1). The current epizootic originating in South-East Asia is a related cluster of outbreaks of Z genotype H5N1.

Table 1 Primary HPAI virus isolates from poultry[1] since 1959 (OIE Reported)

1. A/chicken/Scotland/59 (H5N1)
2. A/turkey/England/63 (H7N3)
3. A/turkey/Ontario/7732/66 (H5N9)
4. A/chicken/Victoria/76 (H7N7)
5. A/chicken/Germany/79 (H7N7)
6. A/turkey/England/199/79 (H7N7)
7. A/chicken/Pennsylvania/1370/83 (H5N2)
8. A/turkey/Ireland/1378/83 (H5N8)
9. A/chicken/Victoria/85 (H7N7)
10. A/turkey/England/50-92/91 (H5N1)
11. A/chicken/Victoria/1/92 (H7N3)
12. A/chicken/Queensland/667-6/94 (H7N3)
13. A/chicken/Mexico/8623-607/94 (H5N2)
14. A/chicken/Pakistan/447/94 (H7N3)
15. A/chicken/NSW/97 (H7N4)
16. A/chicken/Hong Kong/97 (H5N1)
17. A/chicken/Italy/330/97 (H5N2)
18. A/turkey/Italy/99 (H7N1)
19. A/chicken/Chile/2002 (H7N3)
20. A/chicken/The Netherlands/2003 (H7N7)
21. A/chicken/East Asia/2003-2005 (H5N1)[2]
22. A/chicken/Canada-BC/2004 (H7N3)
23. A/chicken/USA-TX/2004 (H5N2)[3]
24. A/ostrich/S. Africa/2004 (H5N2)

[1]Where outbreaks were widespread and affecting more than one species, the isolate from the first outbreak identified is listed.
[2]Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Republic of Korea, Thailand and Viet Nam reported disease in this period; the relationship of these viruses to A/Hong Kong/97 (H5N1) remains unclear at present.
[3]This virus did not kill chickens infected experimentally, but had multiple basic amino acids at the HA0 cleavage site.
Note: In 1996 a moderately pathogenic H5N1 was identified in commercial geese in Guangdong Province in China. This isolate was not reported internationally through the IOE (Office

International de Epizooties) as it was not a chicken outbreak and China is not a signatory to the International Veterinary Reporting agreements but was published in Chinese language in 1998 (Tang et al 1998). This virus is considered the precursor of the current Z genotype.

Since mid-December 2003, 8 Asian countries have confirmed outbreaks of highly pathogenic avian influenza caused by the H5N1 strain. Most of these countries are experiencing outbreaks of this disease for the first time in their histories. In several, outbreaks have been detected in virtually every part of the country. Over the past months, more than 100 million birds have either died of the disease or been culled in Asia. This figure is greater than the total number of poultry affected in the world's previous 5 largest outbreaks combined. It is now considered that (unreported) variants of this H5N1 have been circulating in south East Asia and southern China since about 1996.

Worldwide experience since 1959 supports official statements about the unprecedented nature of the present situation and the unique challenges for control. Unique features of the present situation include:

Concentration of poultry in backyard farms.

a) In several countries experiencing outbreaks, up to 80% of poultry are produced on small farms and backyard holdings in rural areas, where poultry range freely. In China, 60% of the country's estimated 13.2 billion chickens are raised on small farms in close proximity to humans and domestic animals, including pigs. This situation makes implementation of strict control measures, essential to the control of previous outbreaks, extremely difficult. These control measures -- including bird-proof, environmentally controlled housing, disinfection of all incoming persons, equipment, and vehicles, prevention of contact with insects, rodents, and other mechanical vectors -- cannot be applied on small rural farms and backyard holdings.

Economic significance of poultry production.

b) Poultry production contributes greatly to the economies and food supplies of affected countries. The agricultural sector faces the challenge of minimizing losses to industry and subsistence farmers in ways that also reduce health risks for humans. Because many people in the region are so dependent on poultry, appropriate culling may be difficult to implement.

Lack of control experience.

c) Since the disease is new to most countries in the region, very little experience exists at national and international levels to guide the best country-specific control measures. In some countries, announcements of successful culling in certain areas are being followed by subsequent eruptions of disease in the same areas, suggesting reintroduction of the virus, continuing presence in the environment, or inadequate verification of outbreak control.

Lack of resources.

d) Several countries with very widespread outbreaks lack adequate infrastructure and resources, including resources to compensate farmers and thus encourage compliance with government recommendations. In some countries that have announced outbreaks, neither surveillance, to detect the extent of spread nor culling of animals known to be infected is taking place.

The scale of international spread.

e) With so many adjacent countries affected, a region-wide strategy will be needed to ensure that gains in one country are not compromised by inadequate control in another. These unique features will make rapid control and long-term prevention of recurrence extremely difficult to achieve.

Live bird markets.

f) Provide an ideal market for the virus to persist and spread. These markets also great increase the contact between people and the feathers and manure of infected birds (Choi et al 2005).

Changes in method of production of poultry.

g) There have been enormous changes in method of production of poultry in SE-Asia. Thailand has adopted poultry production technologies in response to increasing world demand for poultry protein in food production (Grain Report 2006). Countries such as Laos which have not adopted modern production systems appear to have a lower incidence of disease in poultry, although veterinary infrastructure and cultural difference are considerable impediments to transparency in the region.

International health organizations such as FAO, OIE, and WHO recommend culling as the first line of action for bringing the current outbreaks under control. Unlike other economically important domestic animals, poultry raising takes place in a very short turn-around production system. Provided sufficient resources are available to replace culled poultry stock, countries should not postpone aggressive culling because of fears of long-term consequences on poultry production. Prior to 2000 most outbreaks were identified early and culling resulted in elimination of the variant strain.

Wild birds can play a role in introducing a virus of low pathogenicity into domestic flocks where, if allowed to circulate for several months, it can mutate into a highly pathogenic form. The movement of avian influenza from wild birds to poultry is relatively rare; it is the continued cycle within poultry once it is introduced that is the major challenge. Infected poultry are the species of greatest concern and wild birds should not be culled.

Some previous outbreaks of highly pathogenic avian influenza were difficult to control, even under favourable conditions (concentration of infected birds in well-maintained commercial production facilities, limited geographical occurrence).

a. The 1983 Pennsylvania (USA) outbreak took 2 years to control. Some 17 million birds were destroyed at a direct cost of US$62 million. Indirect costs have been estimated at more than US$250 million.

b. The 2003 outbreak in the Netherlands spread to Belgium and Germany. In the Netherlands, more than 30 million birds -- a quarter of the country's poultry stock -- were destroyed. Some 2.7 million were destroyed in Belgium, and around 400 000 in Germany.

c. In the Netherlands, 89 humans were infected, of whom one (a veterinarian) died. In that outbreak, measures needed to protect the health of poultry workers, farmers, and persons visiting farms included wearing of protective clothing, masks to cover the mouth and nose, eye protection, vaccination against normal seasonal human influenza, and administration of prophylactic antiviral drugs.

Control is more difficult in geographic areas with dense poultry populations.

a. The Italian outbreak of 1999-2000 caused infection in 413 flocks, including 25 backyard flocks, and resulted in the destruction of around 14 million birds. Control was complicated by the occurrence of cases in areas with extremely dense poultry populations. Compensation to farmers amounted to US$63 million. Costs for the poultry and associated industry have been estimated at US$620 million. Four months after the last outbreak ended, the virus returned in a low-pathogenic form, rapidly causing a further 52 outbreaks.

b. Although the last outbreak of highly pathogenic avian influenza in Mexico occurred in 1995, the causative agent, a H5N2 strain has circulated in both a HPAI and LPAI form and has never been entirely eliminated from the country. In its present low-pathogenicity form it continues to circulate despite years of intense efforts, including the administration of more than 2 billion doses of vaccines of varying efficacy.

c. Similarly, the vaccination policy pursued in Pakistan does not appear to have resulted in eradication of the causative agent.

Avoidance of contact between poultry and wild birds, especially ducks and other waterfowl, can help prevent the introduction of a low-pathogenicity virus into domestic flocks. In the current outbreaks with wild migratory birds in Asia:

a. Several of these outbreaks have been linked to contact between free-ranging flocks and wild birds, including the shared use of water sources.

b. Faecal contamination of water supplies is considered a very efficient way for waterfowl to transmit the virus.

c. Virus (low-pathogenicity) has been readily recovered from lakes and ponds where migratory birds congregate.

d. An especially risky practice is the raising of small numbers of domestic ducks on a pond in proximity to domestic chicken and turkey flocks. Domestic ducks attract wild ducks, and provide a significant link in the chain of transmission from wild birds to domestic flocks.

Aggressive control measures, including culling of infected and exposed poultry, are recommended for avian influenza virus subtypes H5 and H7 even when the virus initially shows low pathogenicity. (H5 and H7 are the only subtypes implicated in outbreaks of highly pathogenic disease.)

a. Several of the largest outbreaks (Pennsylvania, Mexico, Italy) initially began with mild illness in poultry. When the virus was allowed to continue circulating in poultry, it eventually mutated (within 6 to 9 months) into a highly pathogenic form with a mortality ratio approaching 100 percent. Moreover, the initial presence of low-pathogenicity virus in these outbreaks complicated diagnosis of the highly pathogenic form.

b. In Italy in 2001 a turkey-adapted strain caused significant mortality in commercial turkeys prior to mutating into a chicken pathogen (Mannelli et al 2005).

SECTION 3 – The Manitoba Situation

3.1 Summary Points:

- British Columbia has higher numbers of large and small poultry flocks of all types as well as more birds on-farm than Manitoba.
- The density of poultry in British Columbia is far higher than in Manitoba.
- The difference in density applies to all classes and sizes of poultry flocks in the two provinces. Areas of Manitoba that are considered to have a high density of poultry have low densities compared to many regions of British Columbia.
- British Columbia has three times as many duck flocks and almost ten times as many ducks on farm as Manitoba. Manitoba however, has a significantly higher population of domestic geese on larger commercial farms.
- The 400 commercial poultry farms (176 table egg, 116 chicken, 40 hatching egg and 66 turkey) in Manitoba contribute $190 million at the farm gate to the provincial economy. Most of the farms are family run operations. The commercial farms are concentrated in the southeast corner of the province.
- The egg, chicken and turkey marketing board have implemented or are developing on-farm food safety assurance programs. General biosecurity and disinfection protocols have been incorporated into these programs.
- All of the meat and table egg chicken farms house their birds indoors on a year round basis. Of approximately 20% of the commercial turkey farms, the birds have access to an outdoor range or paddock in the warmer months of the year. Another 20% of the turkey farms allow the birds' restricted access to the outdoors in an exercise yard.
- June to September are the most common months when the birds have outdoor access. On about half of these farms, the birds also have outdoor access in May and October.
- Because many of the poultry farms in Manitoba are mixed family farms, it is common for them to have more than one type of poultry or livestock.
- Movement of people and equipment between poultry farms is common.
- Manitoba presently has 12 commercial goose farms, most of them located in the south-central part of the province.

- Goose production in Manitoba is seasonal with the goslings being hatched from the end of February to the beginning of June.

- Many commercial goose producers will have two flocks of birds, one being marketed in June or July and the other in September or October.

- Geese are voracious consumers of grasses and hays, produce large volumes of manure, and need access to range as they get older.

- Approximately half of the farms with commercial geese will also raise a single flock of ducks each summer.

- Over half of the commercial goose farms also have meat and table egg chickens on-farm A similar number have pigs as well.

- Less than 10% of the commercial chicken, table egg and turkey farms will raise small numbers of geese or ducks in the summer.

- a small flock of poultry is considered to one with less than1,000 birds. Almost 100% of farms that are members of the provincial marketing board system will have a quota for 1,000 or more birds in a flock.

- In the 2001 Census, 2,142 small poultry flocks were reported on Manitoba farms.

- The number of small poultry flocks identified in the agriculture census has been declining steadily.

- The main reasons cited by small flock owners in keeping poultry are the consumption of the meat and eggs, a hobby and a source of income. Production of "organic" food and a project for children are also often cited as reasons for keeping poultry.

- The meat-type birds are mostly hatched in the months of March to June and then butchered in the summer or fall.

- Most meat-type chicken flocks will be slaughtered by the end of October.

- Because laying hens are often kept in production for one or two years, small flock owners need housing adequate to keep their birds indoors for several months at a time during the cold winter season.

- The health of small flocks is variable and very high mortality is sometimes observed.

- Due the limited economic value of small flocks, small flock owners often will not submit sick birds for examination by a veterinarian.

- A small number of small flock owners, likely under 10%, would be defined as "fancy flock" owners who have an interest in keeping show birds, exotic breeds or old-fashioned breeds of poultry. Fancy flock owners appear to be much more likely than other small flock owners to have geese and ducks as well as chickens on their farms. Some fancy flock owners will take their birds to shows where their animals will be potentially exposed to diseases infecting the other birds at the same event.

- Out of all of the classes of poultry, fancy flock owners are the most likely to obtain birds from out of province sources. They are also the least likely to obtain their new stock through a registered hatchery or approved hatchery supply flock.

- Fancy flock owners are more likely to treat their birds as pets or a hobby.

- While fancy flock owners often let their birds roam outside during the warm months, they generally have a barn or other shelter to house their birds during the cold months.

- Thailand and Manitoba have almost identical land masses. Compared to Thailand, Manitoba has 1/60th the human population, 1/20th the numbers of poultry and 1/1000th the number of flocks.

- Prior to the outbreak of highly pathogenic avian influenza at the beginning of 2003, Thailand was the fourth largest poultry exporter in the world.

- Of the 62 million people at risk in Thailand, 22 people have been infected with H5N1 avian influenza over the last two years. This infection rate is related to the very high density of both people and poultry in the country.

- If all backyard and commercial poultry flocks in Manitoba were to be simultaneously infected with avian influenza, the number of infected flocks would still be less than found to-date in Thailand.

- The level of infection of people in Thailand has been aided by the close contact between birds and humans. Many of the 63 million chickens in backyard flocks roam free through villages and into people's homes.

- Even people who do not raise chickens have more contract than normally found in countries like Canada. Many people in Thailand buy their poultry at live bird markets where they can pick out and handle the birds that they want.

- At live bird markets, they are exposed to birds, manure, feathers and cages that can all be contaminated with the influenza virus. This concentrated interaction between people and poultry does not occur in Manitoba.

- The nesting areas of wild ducks and geese are concentrated outside of the areas of the province with the greatest numbers of small and large poultry flocks.

- In southern Manitoba, the population of “resident” wild ducks and geese is relatively small during the summer months. The fall migration in September and October, however, represents a brief but intense period when wild waterfowl numbers increase dramatically. The highest concentrations would be at several major staging areas in the province.

- Just like people, there is a “flu season” for wild waterfowl. In the northern hemisphere, the number of infected ducks surges in the months of August to November.

- The greatest risk for commercial turkeys in Minnesota coincides with the congregation of enormous numbers of waterfowl at staging areas in the fall.

- Cooler fall temperatures aid the spread of the virus between birds by extending its survival time in water and manure from days to weeks and even months. Outbreaks of avian influenza associated with the waterfowl migration and the cooler temperature in the fall have been noted in Minnesota and Thailand.

- Bird counts at the Oak Hammock Marsh just north of the City of Winnipeg provide a picture of how wild waterfowl numbers increase dramatically during the migration. The total number of wild ducks and geese increase rapidly in the middle of September and then decline significantly by the end of October or middle of November.

3.2 Comparison of Manitoba Poultry Production to British Columbia

In 2004, approximately 17 million poultry were slaughtered in the Fraser Valley of British Columbia to control the first outbreak of Avian Influenza in Canada since 1966. In 2005, two commercial flocks of ducks were found to be infected with an H5 subtype of avian influenza and 50,000 birds were destroyed. Comparison of conditions in British Columbia and Manitoba will help determine if the two provinces share the same level of risk for avian influenza outbreaks.

British Columbia has higher numbers of large and small poultry flocks of all types as well as more birds on-farm than Manitoba. The great poultry population is related to the greater human population and the milder climate that is more conducive to small scale poultry production.

Table 2. Number of Small and Large Flocks and Total Birds Numbers Reported on Farms in Statistics Canada Census 2001

	Number of Small Flocks (1 to 999 birds)		Number of Large Flocks (1,000 or more birds)		Total Number of Birds on Farm	
	BC	MB	BC	MB	BC	MB
Broilers, roasters & cornish	1,478	584	298	149	13,972,170	3,980,599
Pullets intended for laying	1,252	190	115	71	1,436,793	1,024,627
Laying hens	4,278	995	197	203	3,411,384	2,980,515
Turkeys	727	135	42	63	819,569	694,248
Other poultry	1,458	428	39	17	847,617	112,067

The density of poultry in British Columbia is far higher than in Manitoba, not just due to higher bird numbers, but also due to greater competition for a limited land base. Housing and industry occupies a large portion of the land; farms and acreages are forced closer together on the farm land that remains. Sixteen census divisions in British Columbia have higher poultry flock densities than found in all but one census division in Manitoba.

The difference in density applies to all classes and sizes of poultry flocks in the two provinces. Areas of Manitoba that are considered to have a high density of poultry have low densities compared to many regions of British Columbia.

The lower bird density in flock numbers is most noticeable for small flocks in Manitoba *versus* British Columbia.

The domestic waterfowl population in the two provinces is markedly different. British Columbia has three times as many duck flocks and almost ten times as many ducks on farm as Manitoba. Because healthy ducks can be infected with avian influenza, they are a potentially undetected source of the virus.

*Table 3. **Ducks and Geese Reported on Farms, Statistics Canada Census 2001***

	Number of Flocks		Number of Birds	
	British Columbia	Manitoba	British Columbia	Manitoba
Ducks	734	194	124,444	13,044
Geese	349	138	2,739	59,622

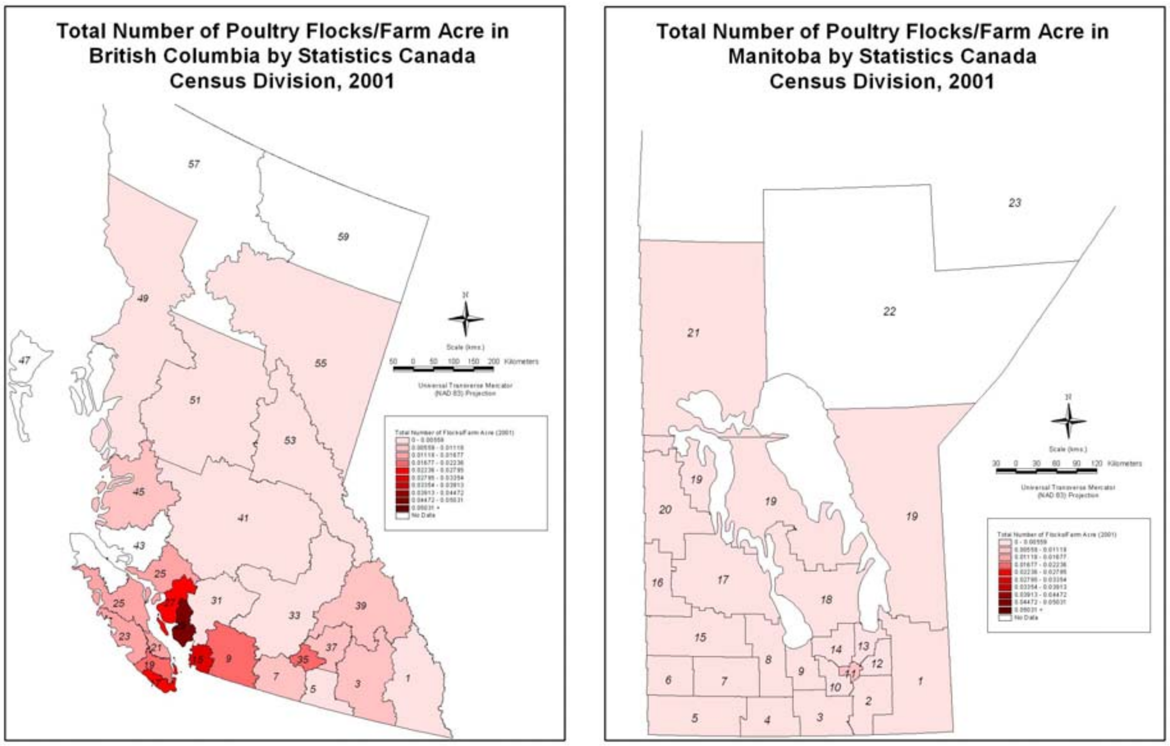


Figure 1. Poultry Density Manitoba and BC. The difference in density applies to all classes and sizes of poultry flocks in the two provinces. Areas of Manitoba that are considered locally to have a high density of poultry have low densities compared to most regions of British Columbia.

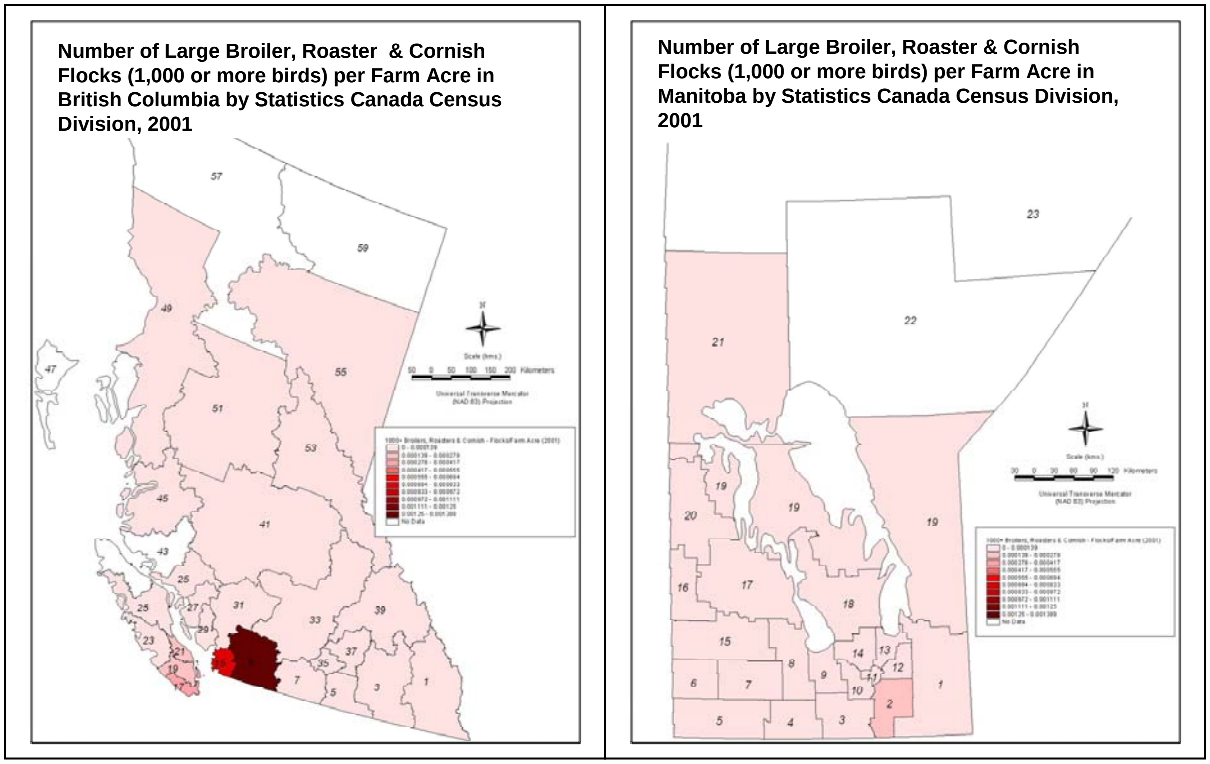


Figure 2. Comparison Commercial Meat Type birds BC-MB

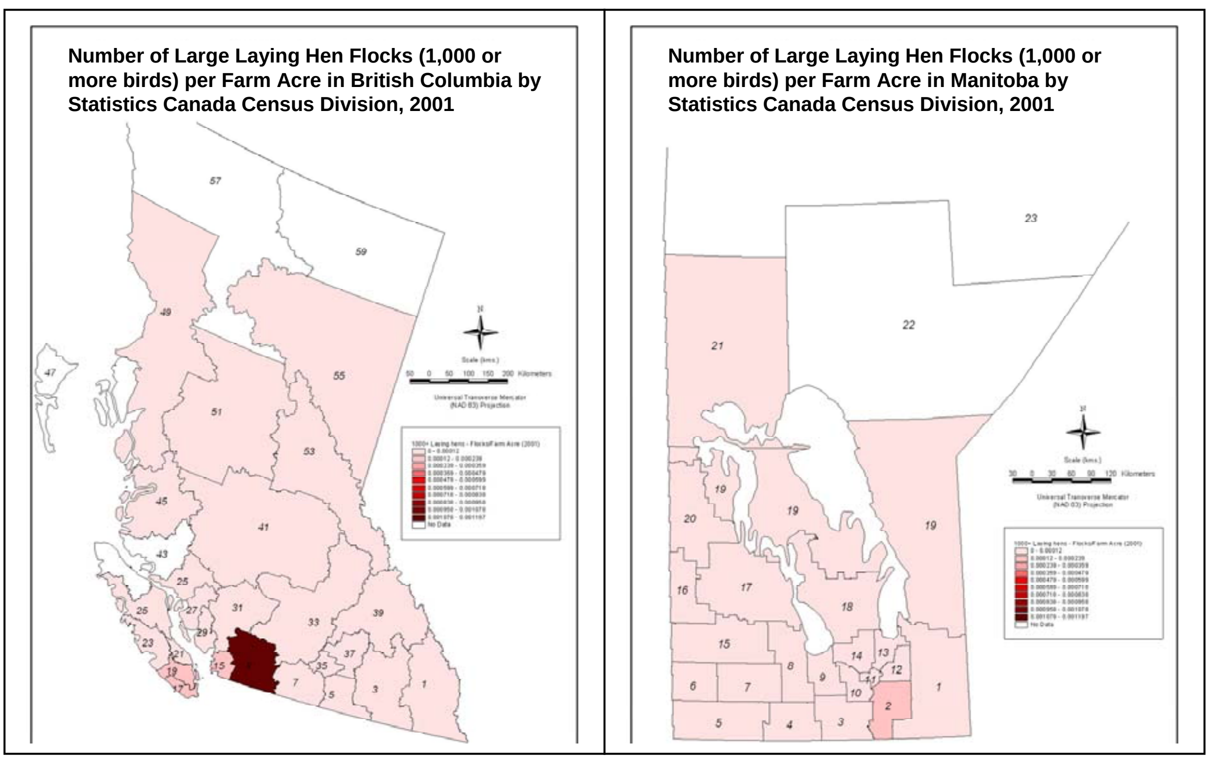


Figure 3. Comparison Commercial Egg Layer Flocks BC-MB

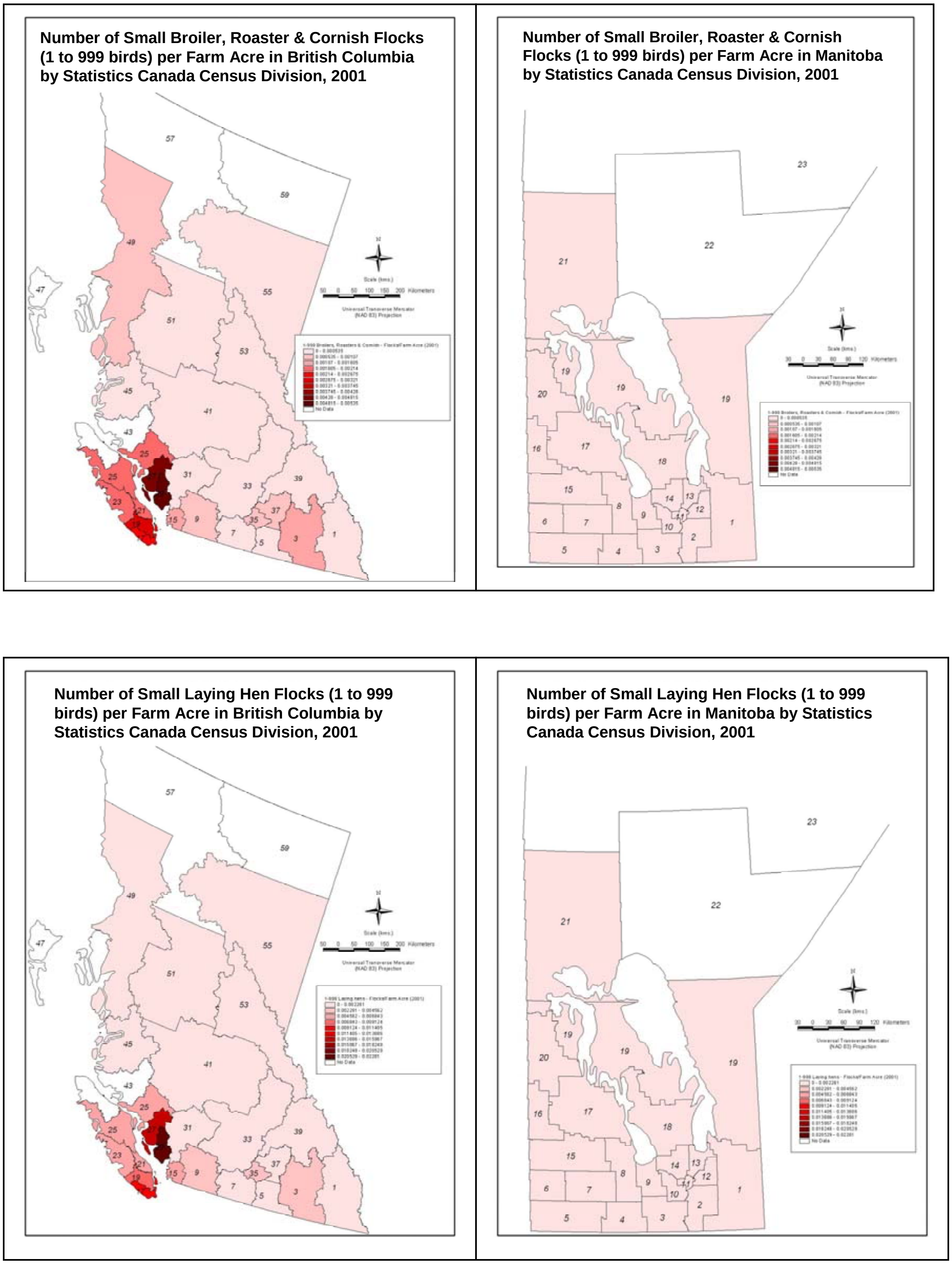


Figure 4. Non Commercial Layer Flock Comparison and Small Flock Meat Production Comparison

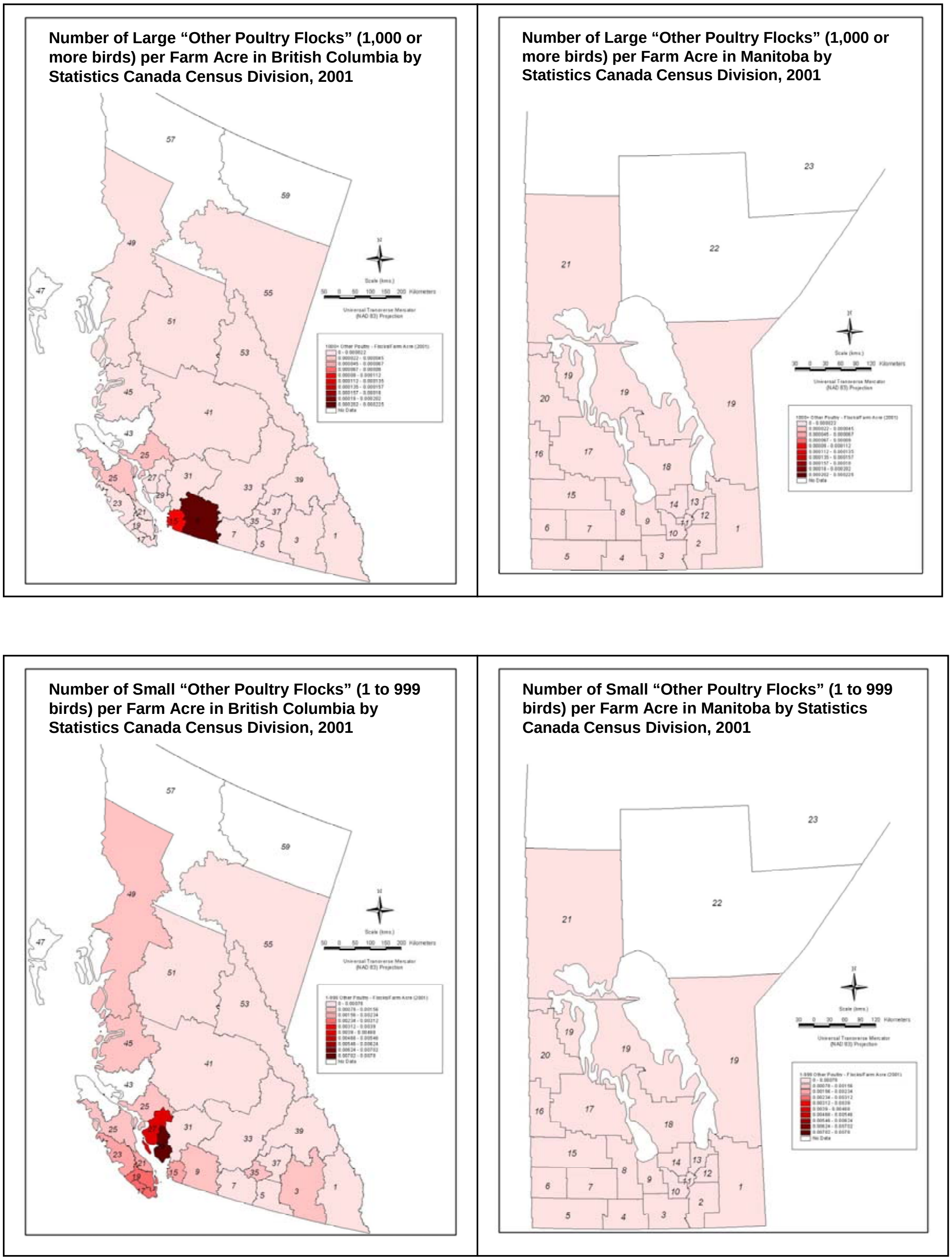


Figure 5. Commercial Other Poultry Comparison and Small Flock Other Poultry Comparison. Other poultry includes ducks, geese, ratites, game birds and wild turkeys.

3.3 *Poultry Demographics in Manitoba*

Commercial Chicken, Table Egg, Hatching Egg and Turkey Farms

The 400 commercial poultry farms (176 table egg, 116 chicken, 40 hatching egg and 66 turkey) in Manitoba contribute $190 million at the farm gate to the provincial economy. Most of the farms are family run operations. The commercial farms are concentrated in the southeast corner of the province with approximately 80% of them located within a 100 km radius of Winnipeg. The allied industry which serves the commercial industry is extensive with all producers buying their chicks or poults from a commercial hatchery and most purchasing feed from a commercial feed mill. The processing industry is highly concentrated and almost of the production is handled via two poultry meat processing plants, two egg grading stations and two egg processors.

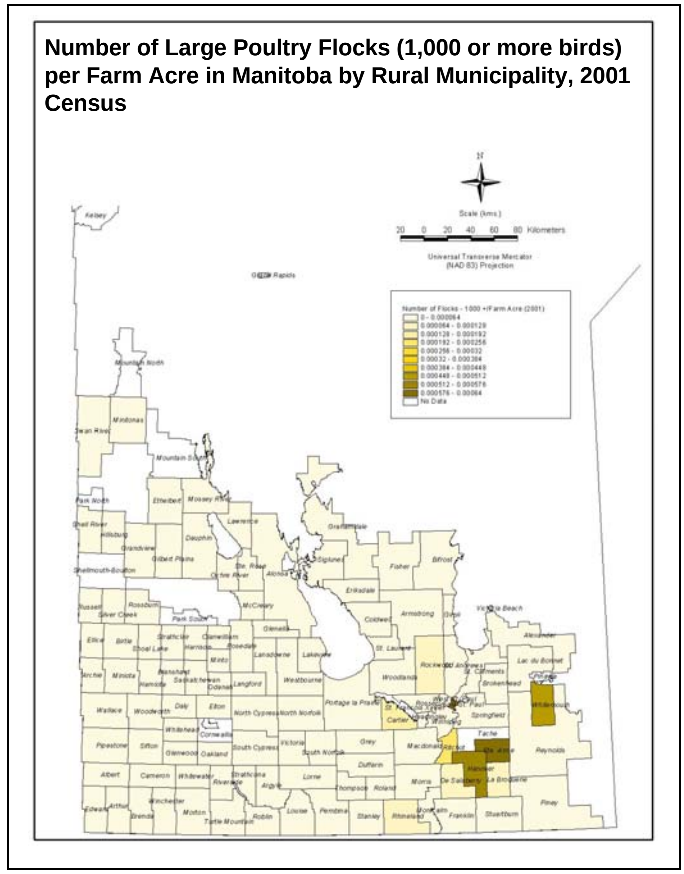


Figure 6. Large Poultry Flock Distribution in Manitoba

The egg, chicken and turkey marketing board have implemented or are developing on-farm food safety assurance programs. General biosecurity and disinfection protocols have been incorporated into these programs. The boards have or will be hiring inspectors to ensure implementation of these protocols.

All of the meat and table egg chicken farms house their birds indoors on a year round basis. Of approximately 20% of the commercial turkey farms, the birds have access to an outdoor range or paddock in the warmer months of the year. Another 20% of the turkey farms allow the birds' restricted access to the outdoors in an exercise yard attached to their barn. For both ranges and exercise yards, June to September are the most common months when the birds have outdoor access. On about half of these farms, the birds also have outdoor access in May and October.

Almost all of the broiler farms and hatching egg farms supplying the meat chicken industry are single age farms where all of the barns are emptied and cleaned at the end of each flock. The table egg barns are cleaned at the end of each flock but approximately half of the farms have more than one age of hens or pullets. These multiple age farms are not normally totally depopulated at one time. The turkey barns are cleaned out at the end of each flock or season. Over half of the turkey farms will have more than one age of birds on-site at some time of the year. About one quarter of the turkey farms have barns where different flocks are separately by a wall or hallway.

Because many of the poultry farms in Manitoba are mixed family farms, it is common for them to have more than one type of poultry or livestock. Close to half of the turkey farms also have meat or egg-type chickens while approximately 20% of the table egg farms will also have broiler chickens or turkeys. About ¼ of the turkey and egg farms have pigs and a small number have ducks or geese. The broiler chicken industry also has a large number of farms with links to the egg, turkey and pig industries.

Movement of people and equipment between poultry farms is common. Veterinarians, feed and hatchery service people, electricians, and truck drivers are examples of people who travel between all types of poultry farms. In the chicken and turkey industries, the movement of catching crews and catching equipment occurs frequently. In the egg industry, the movement of egg trucks, pallets and egg trays occurs every week on a year round basis. Much of this activity occurs with the people or equipment moving between farms on the same day.

In the table egg and hatching egg industries, it is common for the immature pullets to be grown on one farm and then brought into egg production on another farm. On hatching egg farms, roosters from an outside farm are sometimes added in the middle of the production cycle to help increase fertility. Bird movement can introduce a wide range of diseases to table or hatching egg farms.

Commercial Goose and Duck Farms

Manitoba presently has 12 commercial goose farms, most of them located in the south-central part of the province. Five of the farms have goose breeder flocks and one has a duck breeder flock. The number of commercial goose farms has declined from the 28 active in the industry when Pembina Packers, one of the two goose processing plants in Manitoba, closed its doors in 1998. It has been estimated that 220,000 geese were grown on commercial farms in Manitoba in 1998. Today, half of the farms ship their geese to Northern Goose Processors Ltd. in Teulon, Manitoba and the remainder ship to Schiltz Goose Farms in Sisseton, South Dakota. No firm data is available on the number of geese produced but is estimated that 150,000 geese were produced in Manitoba in 2005. Few farms in Manitoba produce market ducks on a commercial scale.

The total number of farms with geese and ducks is much larger than the number of commercial farms. In the 2001 census, 138 Manitoba farms reported having geese with 60,000 geese on-farm on census day (down from 209 farms and 120,000 geese in 1996.) Most of these geese would have been on commercial farms. Manitoba accounted for 46% of the geese reported in Canada in 2001 and 62% in 1996. In contrast, the 194 farms reporting ducks in 2001 had only 13,000 ducks and accounted for 1% of the ducks in Canada.

Northern Goose (Teulon) is the only federally registered goose processing plants on the Canadian Prairies. The four other federal plants that process any geese are located in British Columbia and Quebec. Northern Goose is one of the three federally registered poultry processing plants in Manitoba that handles poultry. It is the only plant with the waxing equipment needed to remove the pin feathers from waterfowl and has made extensive investments in the equipment needed to produce high quality goose down.

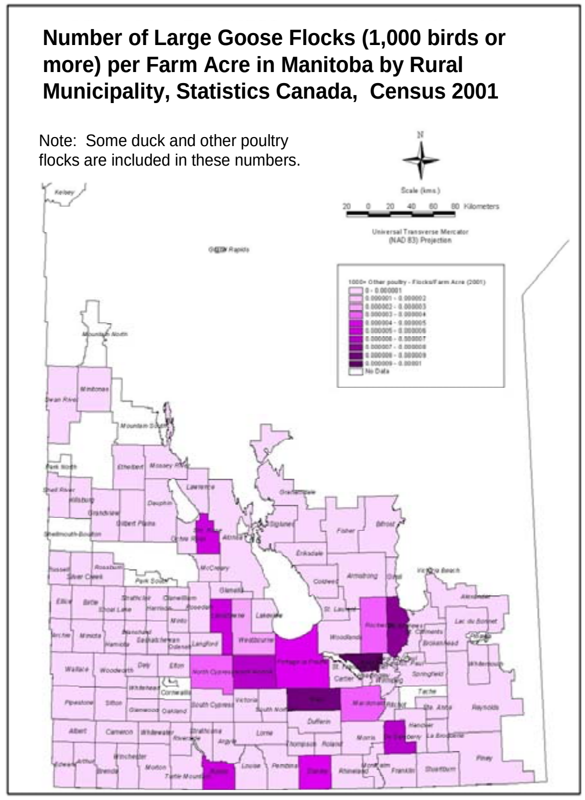


Figure 7. Goose Flock Distribution MB.
Note: For display purposes, a narrower range of flock sizes is used with this figure.

Goose production in Manitoba is seasonal with the goslings being hatched from the end of February to the beginning of June. The geese are marketed at 14 to 18 lbs. live weight at 16 to 20 weeks of age. Many commercial goose producers will have two flocks of birds, one being marketed in June or July and the other in September or October. The birds are kept indoors for the first 2 to 7 weeks of their life and then moved to an outdoor range when they are fully feathered enough to adjust to the outdoor temperature. Geese are voracious consumers of grasses and hays, produce large volumes of manure, and need access to range as they get older. Farms with market geese typically have some or all of their birds outdoors in the months of May to October. Goose breeders are typically allowed access to an outside paddock or exercise yard on a year round basis. Outdoor production is the norm for geese world wide.

Approximately half of the farms with commercial geese will also raise a single flock of ducks each summer with most of these raising 1,000 or more ducks at once. The duck flock will typically have access to the outdoors in the months of June to September or October. Some of the duck flocks are kept indoors and others have outdoor access. Unlike goose production, duck production can be adapted to total confinement.

Over half of the commercial goose farms also have meat and table egg chickens on-farm A similar number have pigs as well.

Less than 10% of the commercial chicken, table egg and turkey farms will raise small numbers of geese or ducks in the summer. Typically, they might raise 100 geese and 500 ducks for on-farm or local consumption.

Small Farm Poultry Flocks

For discussion purposes, a small flock of poultry is considered to one with less than 1,000 birds. Almost 100% of farms that are members of the provincial marketing board system will have a quota for 1,000 or more birds in a flock. Without quota, any farm in Manitoba can produce 999 meat-type chickens, 99 egg-type hens and 99 turkeys. Some farms are allowed to have up to 499 laying hens by special permit in the absence of quota. The produce from flocks with less than 1,000 birds will be mostly used for consumption on-farm or locally.

In the 2001 Census, 2,142 small poultry flocks were reported on Manitoba farms. The small flocks reported included 584 meat-type chicken flocks, 995 egg layer flocks, 190 pullet flocks, 135 turkey flocks and 428 flocks of “other poultry”. Geese and ducks accounted for approximately ¾’s of the flocks in the other poultry category with the rest being ostriches, emus, pheasant, quail, wild turkeys and roosters. The majority of the small flocks were very small, with 60% of the meat-type chicken flocks and 85% of the egg, turkey and other poultry flocks having 99 or fewer birds per flock. Many farms will have more than one class of poultry (more than one flock); the number of farms with poultry will be less than the 2,142 flocks reported in the census.

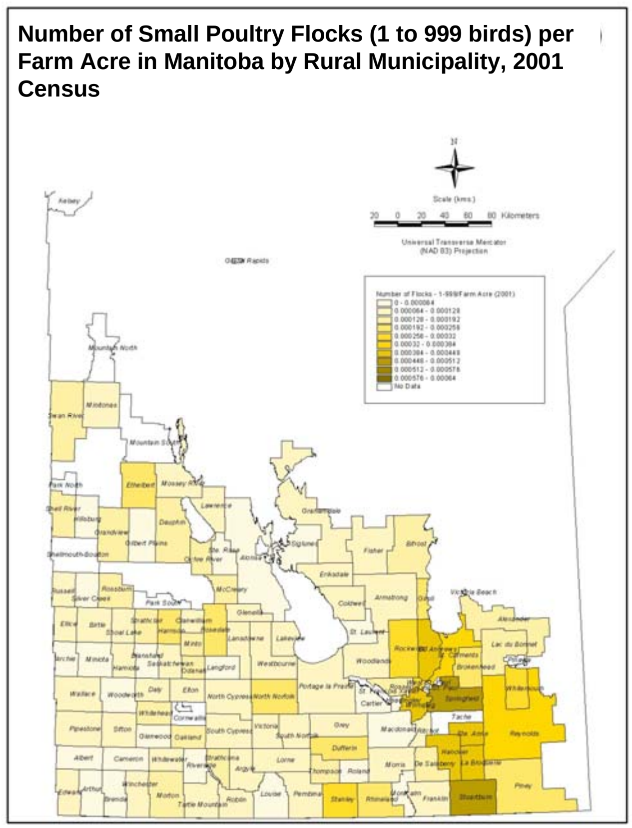


Figure 8 Small flock distributions MB.

The number of small poultry flocks identified in the agriculture census has been declining steadily (see Table 4). Since 1991, the number of small flocks has decreased faster than the number of large flocks.

Table 4 Number of Small and Large Flocks Reported in Manitoba 1991, 1996 and 2001 Census

	Census Year		
	1991	**1996**	**2001**
Number of Small Flocks (999 birds or less)			
Broiler chickens	2,258	615	584
Laying hens and pullets	2,544	1,431	1,185
Turkeys	538	195	135
Other Poultry	860	740	428
Number of Large Flocks (1,000 birds or more)			
Broiler chickens	166	143	149
Laying hens and pullets	355	327	274
Turkeys	68	67	63
Other Poultry	31	25	17

The main reasons cited by small flock owners in keeping poultry are the consumption of the meat and eggs, a hobby and a source of income. Production of "organic" food and a project for children are also often cited as reasons for keeping poultry.

The chicks and poults for most small flocks of meat-type chicken and turkey flocks are sourced from federally registered and inspected hatcheries. The broiler chicks and poults are mostly sold through a network of chick dealers across the province. A smaller percentage of the egg laying chicks are sourced from commercial hatcheries. Some small egg flock owners purchase their birds as mature, end-of-lay hens from commercial egg farms. Most of the fancy or old-fashioned breeds are classified as egg layer strains and many are obtained by trading with other small flock owners.

The meat-type birds are mostly hatched in the months of March to June and then butchered in the summer or fall. Many small flock owners start their chicks in make-shift housing that is only adequate until the birds are about 6 weeks old. The birds will then be given access to the outdoors. Typically, the meat-type chickens are grown until they reach a roaster weight of 8 to 10 lbs. live weight or 5 to 7 lbs. dressed weight. While the birds are normally started on a diet produced by a commercial feed mill, many are grown out on a low quality feed mixture and take anywhere from 10 to 18 weeks to reach this weight. Most meat-type chicken flocks will be slaughtered by the end of October. With proper feeding and management, the flocks can reach roaster weight at 9 weeks of age and the time spent outdoors can be reduced to 3 or 4 weeks. The flocks may be processed on-farm or at two provincially inspected or three uninspected custom processing plants. Only birds processed at an inspected plant can be sold through stores, public markets or restaurants.

Eggs from the small table egg flocks are mostly consumed on-farm or sold to neighbors. Because laying hens are often kept in production for one or two years, small flock owners need housing adequate to keep their birds indoors for several months at a time during the cold winter season. The requirements for setting up a federally registered grading station are fairly straight forward and approximately 20 small, inspected graders can be found across the province. Eggs graded at inspected graders can be sold through stores, public markets and restaurants.

The health of small flocks is variable and very high mortality is sometimes observed. Due to variable management and feeding, the mortality in these problem flocks may be metabolic or nutritional and not infectious. Of the infectious losses, some are caused by parasites such as worms or coccidia which pose little threat to commercial poultry. A small number of flocks will be infected with diseases such Infectious Laryngotracheitis which are a major threat to other poultry. Many small flock owners are not trained to determine whether high death losses are caused by management, nutrition or infectious agents. Due the limited economic value of small flocks, small flock owners often will not submit sick birds for examination by a veterinarian even when a problem has killed half or more of their flock. Because only one private veterinarian in Manitoba specializes in poultry, small flock owners cannot always access specialized poultry health advice.

A small number of small flock owners, likely under 10%, would be defined as “fancy flock” owners who have an interest in keeping show birds, exotic breeds or old-fashioned breeds of poultry. Fancy flock owners appear to be much more likely than other small flock owners to have geese and ducks as well as chickens on their farms. Some fancy flock owners will take their birds to shows where their animals will be potentially exposed to diseases infecting the other birds at the same event. Owners who bring their birds back to their farm from a show or trade for new birds at a show, risk introducing new diseases to their flock. Out of all of the classes of poultry, fancy flock owners are the most likely to obtain birds from out of province sources. They are also the least likely to obtain their new stock through a registered hatchery or approved hatchery supply flock. Most of the birds are traded as adults or chicks instead of as hatching eggs. Many fancy flock owners will hatch chicks on-farm and the chicks will be exposed to any disease organisms infecting the older birds on their farm. Fancy flock owners are more likely to treat their birds as pets or a hobby and are somewhat less likely to raise them as a source meat or eggs. While fancy flock owners often let their birds roam outside during the warm months, they generally have a barn or other shelter to house their birds during the cold months. Fancy flock owners appear to be more likely to submit sick birds to a veterinarian than other small flock owners.

Sources:
2003 Manitoba Agriculture Yearbook, Manitoba Egg Producers, Manitoba Turkey Producers; 2001 Census of Agriculture (Statistics Canada)

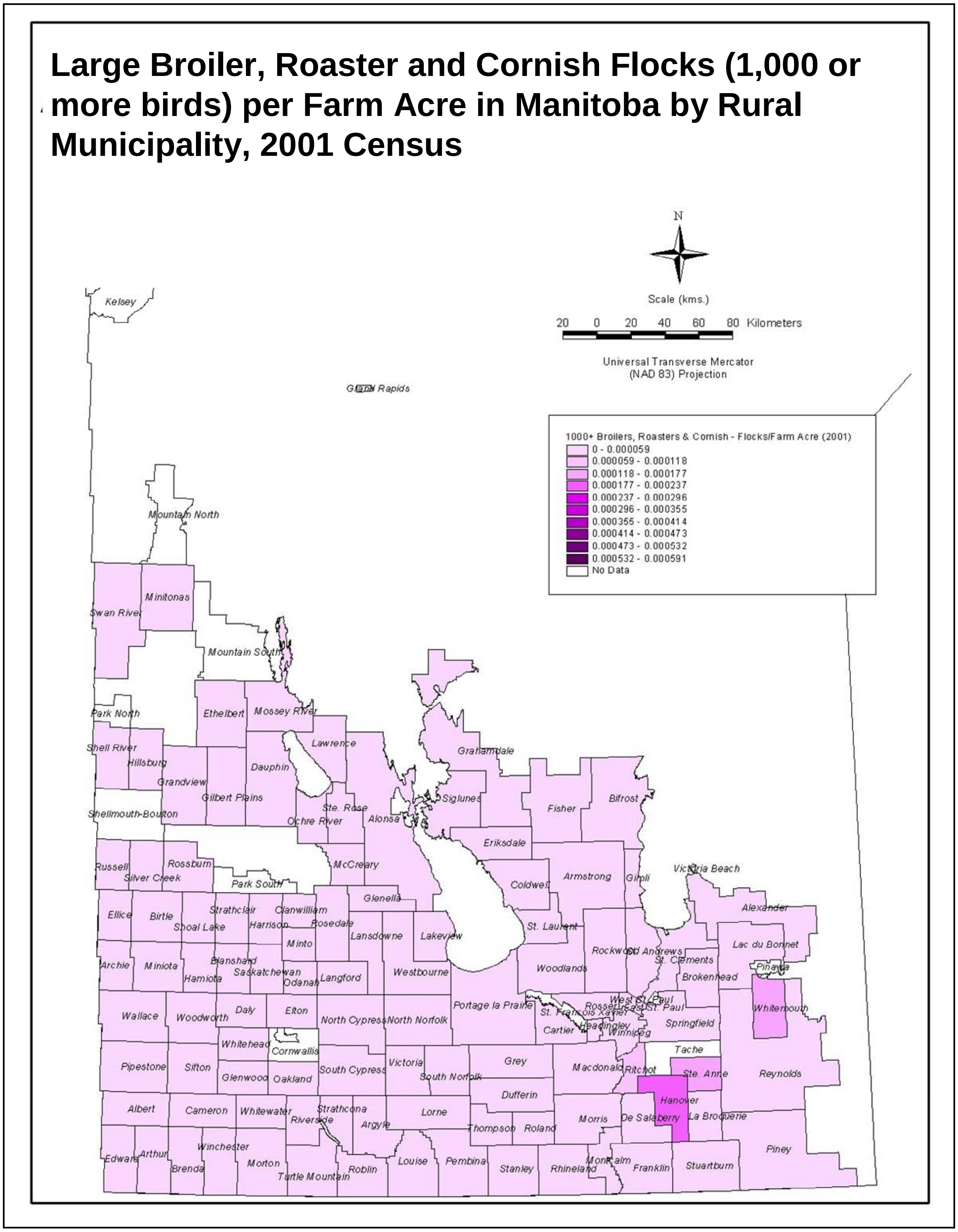


Figure 9. Commercial meat poultry production is largely concentrated within 50 km of the 2 slaughter facilities located in Winnipeg and Blumenort.

3.4 Comparison of Manitoba Poultry Production to Thailand

Demographics of Poultry Production in Manitoba and Thailand

To compare Manitoba to a region of world where Asian H5N1 avian influenza is a problem, it is useful to consider the situation in Thailand (Table 5). Thailand and Manitoba have almost identical land masses (approximately 500,000 square kilometers). Thailand has both a very large number of small, backyard flocks and a very sophisticated commercial poultry industry. Prior to the outbreak of highly pathogenic avian influenza at the beginning of 2003, Thailand was the fourth largest poultry exporter in the world and was a major supplier for Japan and the European Union. Thailand has an aggressive avian influenza surveillance program and regularly reports its findings to the international community.

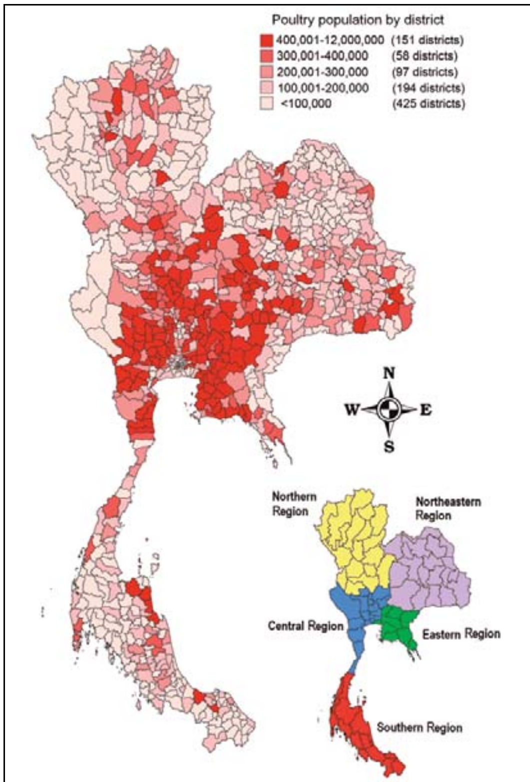
Table 5 .Thailand and Manitoba: Comparison of Land Mass, Human Population, Poultry Population

Size of Country/Province	**Thailand**		**Manitoba**	
Land Mass	513,000 square kilometers		553,000 sq. kilometers	
Human Population	62,300,000 people		1,100,000 people	
Poultry Populations (2003)				
Type of Bird	Number of Flocks	Number of Birds	Number of Flocks	Number of Birds
▪ Backyard chickens	2,136,000	63,091,000	1,769	300,000[a]
▪ Ducks	680,000	23,800,000	194	13,000
▪ Geese	14,600	308,000	138	60,000
▪ Broilers	45,700	165,300,000	149	3,680,000
▪ Layers	36,500	24,310,000	220	4,000,000
Total (includes quail & other)	2,920,000	280,520,000	2,862	8,992,000
H5N1 Avian Influenza Infected Poultry Flocks				
▪ 2003	1,769 flocks		0 flocks	
▪ 2004	1,685 flocks		0 flocks	
▪ 2005	Estimated 75 flocks		0 flocks	
H5N1 Infections in People				
▪ 2003	0 cases		N/A	
▪ 2004	17 cases (12 deaths)		N/A	
▪ 2005	5 cases (2 deaths)		N/A	

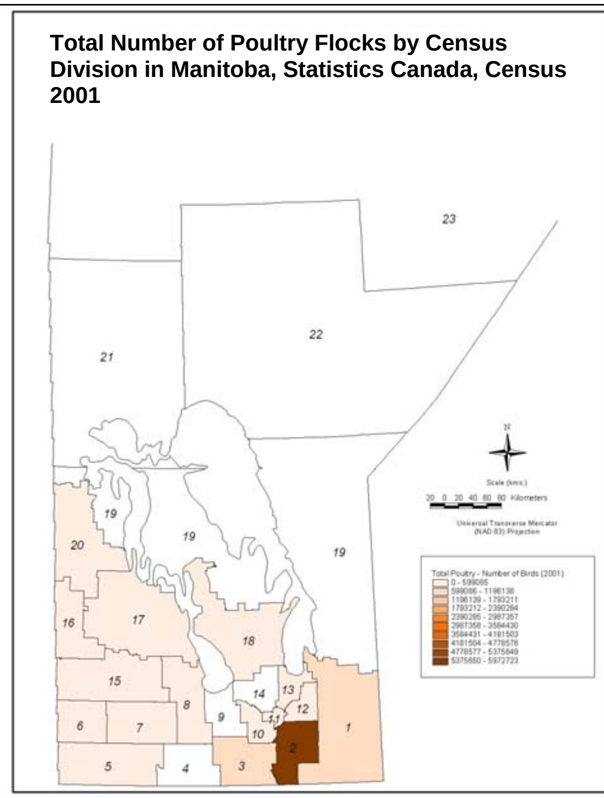
[a] Estimated based on 75 birds per flock under 99 birds and 500 birds per flock of 100 to 999 birds Sources: Teinsin et al., November, 2005. Highly pathogenic avian influenza H5N1, Thailand, 2004Emerging Infectious Diseases, www.cdc.gov.gov/eid; USDA Foreign Agricultural Service, 2006. Thailand poultry and products semi annual 2006 (Gain Report TH6012); World Health Organization, Cumulative Number of confirmed human cases of avian influenza A/(H5N1) reported to WHO, February 20, 2006, www.who.int/csr/disease/avian_influenza/country/en; Statistics Canada, 2001 Census of Agriculture.

Of the 62 million people at risk in Thailand, 22 people have been infected with H5N1 avian influenza over the last two years. This infection rate is related to the very high density of both people and poultry in the country. While only 0.06% of the poultry flocks in the county have been infected, over 3,500 infected flocks have still been identified since the end of 2003. The number of infected flocks found in Thailand has been greater than the total number of small and large poultry flocks that can normally found in Manitoba at one time. If all backyard and commercial poultry flocks in Manitoba were to be simultaneously infected with avian influenza, the number of infected flocks would still be less than found to-date in Thailand.

Figure 10. Comparison of Poultry Density in Thailand and Manitoba: Birds by District



Production in Thailand (birds)



The level of infection of people in Thailand has been aided by the close contact between birds and humans. Many of the 63 million chickens in backyard flocks roam free through villages and into people's homes. Over half of the infected flocks in Thailand have been backyard chicken flocks and the close contact of these birds with people is a problem. Even people who do not raise chickens have more contract than normally found in countries like Canada. Many people in Thailand buy their poultry at live bird markets where they can pick out and handle the birds that they want either slaughtered for them at the market or take home to process themselves. At live bird markets, they are exposed to birds, manure, feathers and cages that can all be contaminated with the influenza virus. This concentrated interaction between people and poultry does not occur in Manitoba.

The control of avian influenza in Thailand and other South East Asian countries has been difficult for a number of reasons:

- Large numbers of duck flocks. Ducks have been identified in Thailand as "silent carriers" of the disease because they do not appear sick but can spread it to people and poultry.
- The movement of ducks to graze rice fields in different parts of the country.
- Live bird markets continually expose new birds to the disease.
- The cultural acceptance of cock fighting. Thailand has tried unsuccessfully to ban the practice.
- Movement of live and dead poultry across borders.
- Poor biosecurity in small flocks.

The ability to raise poultry and ducks outdoors on a year round basis also means that there is not natural break in outdoor production in Thailand.

The Thai government has been aggressively fighting the outbreak of avian influenza by using control measures such as,

- Eradication of any flock detected with H5N1 avian influenza or which has over 10% mortality in one day
- Quarantine zones 5 km around infected flocks
- Comprehensive surveillance designed to test birds in every village in the country every six months
- Testing of commercial flocks prior to being allowed to go to market
- Discouraging cock fighting, poultry shows and grazing of ducks.

While outdoor production has not been banned, the number of infected flocks has dropped dramatically.

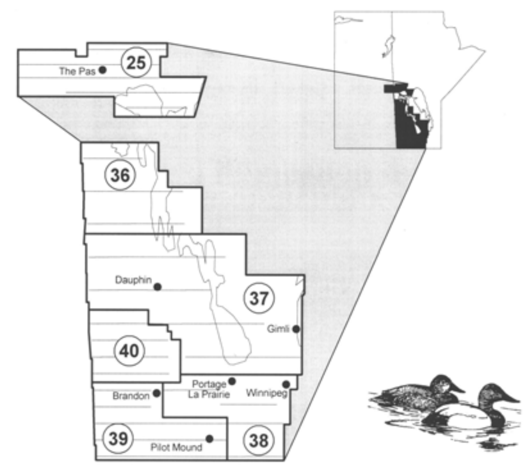
3.5 Wild Duck and Goose Demographics in Manitoba

The nesting areas of wild ducks and geese are concentrated outside of the areas of the province with the greatest numbers of small and large poultry flocks. The results from a survey of wild duck and goose numbers and habitats in May, 2005 are displayed in Table 6. Region 38 in this survey corresponds with the areas in south-eastern and south-central Manitoba that have the greatest numbers of large and small flocks in the province. The survey confirms that nesting areas of wild waterfowl are concentrated away from the poultry production areas (outside of Region 38). The distribution of the number of ponds identified in the May survey helps to explain the differences in wild waterfowl nesting sites across the province (Table 6).

Table 6. Waterfowl breeding population estimates, (thousands of birds), May, 2005

Table 6a						
	Wild bird survey region					
	25	36	37	38	39	40
Mallard ducks	27	19	155	54	97	130
Other ducks	150	29	349	65	374	364
Total Ducks	177	48	504	119	471	494
Canada Geese	7	9	23	2	6	19
Source: U.S. Fish & Wildlife Service/Cdn Wildlife Service						

Table 6b. Number of ponds ('000's) counted in May, 2005and size of survey region ('000's square miles)						
	Wild bird survey region					
	25	36	37	38	39	40
Ponds ('000's)		57	312	38	139	208
Area (000's of square miles)	7.7	5.5	16.5	5.7	6.6	4.5
Source: U.S. Fish & Wildlife Service/Cdn Wildlife Service						



Waterfowl Breeding Population Survey, May 2005 - Southern Manitoba and Saskatchewan River Delta U.S. Fish & Wildlife Service /Canadian Wildlife

In southern Manitoba, the population of "resident" wild ducks and geese is relatively small during the summer months. The fall migration in September and October, however, represents a brief but intense period when wild waterfowl numbers increase dramatically. The highest concentrations would be at several major staging areas in the province – Oak Hammock Marsh, Whitewater Lake, Lake Dauphin, Big Grass Marsh near Gladstone, The Pas and the City of Winnipeg. In the poultry production areas of the province, some smaller staging areas of note would be Island Lake Park in the City of Portage La Prairie, Moose Lake, Tall Grass Prairie Reserve at Stuartburn, Whitemouth Lake and the Rat River Wildlife Management Area. North of the City of Winnipeg, the Hecla and Riverton area marshes and Dog Lake are notable staging and nesting areas. Due to changing habitat, the Delta Marsh waterfowl numbers are declining.

Just like people, there is a “flu season” for wild waterfowl. In the northern hemisphere, the number of infected ducks surges in the months of August to November. A peak in numbers of infected waterfowl during the fall has been documented in Minnesota, Louisiana, Germany, Maryland, Minnesota, and Thailand (Halvorson et al 1985; Stallknecht et al 1990; Süss et al 1994; Slemons et al 2003; Tiensin et al 2005). In Minnesota, a peak in the incidence of infected, outdoor commercial turkey flocks occurs approximately 6 to 8 weeks after peak period of shed of influenza virus by wild ducks (Halvorson et al 1985). The greatest risk for commercial turkeys in Minnesota coincides with the congregation of enormous numbers of waterfowl at staging areas in the fall. Young susceptible birds gain their flight feathers, mix with increased number of older birds, and become infected. A high incidence of avian influenza in juvenile versus mature ducks has been observed in Minnesota, Maryland and Louisiana (Hanson et al 2003, Slemons et al 2003; Stallknecht et al 1990). Cooler fall temperatures aid the spread of the virus between birds by extending its survival time in water and manure from days to weeks and even months. Outbreaks of avian influenza associated with the waterfowl migration and the cooler temperature in the fall have been noted in Minnesota and Thailand (Halvorson et al 1985; Tiensin et al 2005).

Bird counts at the Oak Hammock Marsh just north of the City of Winnipeg provide a picture of how wild waterfowl numbers increase dramatically during the migration (Table 7). The total number of wild ducks and geese increase rapidly in the middle of September and then decline significantly by the end of October or middle of November. At least for Canada Geese, the bird counts at Oak Hammock Marsh mirror that in the other major staging area – the City of Winnipeg. The peak Canada Goose counts during the fall migration are very similar in both locations (115,000 to 150,000 geese).

Table 7 Number of Canada Geese, Snow Geese and Ducks Counted at Oak Hammock Marsh

	Date Birds Counted							
	Summer	Sept 15	Sept 22	Sept 29	Oct. 6	Oct. 13	Oct. 20	Nov. 3
Canada Geese	416	10,000	67,700	100,500	103,850	61,100	100,150	79,500
Snow Geese	1	50,000	94,650	144,300	93,100	83,100	50,100	15,600
Ducks	2,759	2,000	21,500	43,000	32,550	68,950	87,450	40,000

Note: 1) Summer count from Ducks Unlimited web page, “Summer Bird Census” for 1999 to 2003, http://www.ducks.ca/ohmic/english/feature/scensus.html;
2) Sept. 8 to Nov. 3 counts are averages for 2004 and 2005 supplied by Wildlife Branch, Manitoba Conservation.

SECTION 4 - Understanding and Communicating Risks

4.1 Summary Points

- A combination of the impact of loss rating and the vulnerability rating can be used to evaluate the potential risk to the industry from a given threat.

	These risks are high. Countermeasures recommended to mitigate these risks should be implemented as soon as possible.
	These risks are moderate. Countermeasure implementation should be planned in the near future.
	These risks are low. Countermeasure implementation will enhance security, but is of less urgency than the above risks.

4.2 Risk Analysis

A combination of the impact of loss rating and the vulnerability rating can be used to evaluate the potential risk to the industry from a given threat. A sample risk matrix is depicted in Table A. High risks are designated by the red cells, moderate risks by the yellow cells, and low risks by the green cells.

Table A. Matrix identifying levels of risk

	Probability of Occurrence in a Temporal Span			
Impact of Event	**Very High**	**High**	**Moderate**	**Low**
Devastating				
Severe				
Noticeable				
Minor				

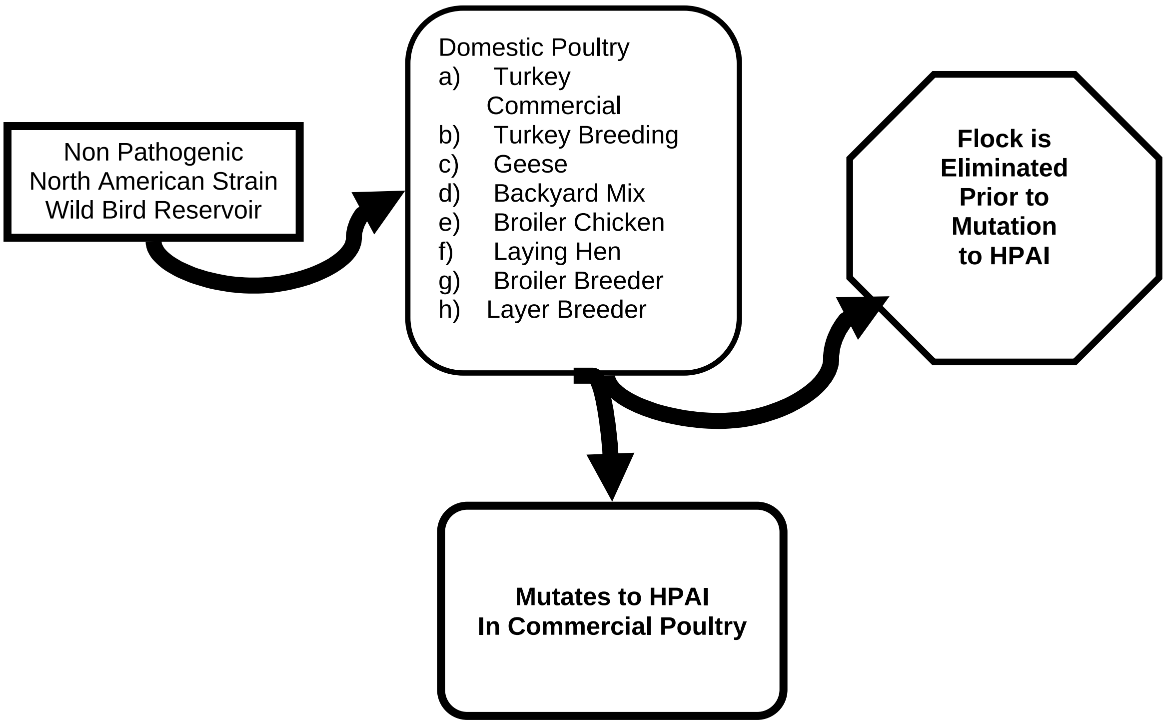
The ratings in the matrix can be interpreted using the explanation shown in Table B.

Table B. Interpretation of the risk ratings

(red)	These risks are high. Countermeasures recommended to mitigate these risks should be implemented as soon as possible.
(yellow)	These risks are moderate. Countermeasure implementation should be planned in the near future.
(green)	These risks are low. Countermeasure implementation will enhance security, but is of less urgency than the above risks.

Impact of Events: In poultry, an example of a devastating event would be an uncontrolled outbreak of non-zoonotic influenza which triggers prolonged border closure and requires the eradication of large numbers of infected and uninfected flocks. In people, an example of a devastating event would be the emergence and spread of a strain of avian influenza that requires the hospitalization of large numbers of people.

SECTION 5 - Risk Pathway 1 Classical pathway of introduction of influenza-A



Risk Pathway 1

***Figure 11. Classical pathway of introduction of influenza-A into domestic poultry and emergence of Highly Pathogenic Avian influenza*.**

Table 7. Matrix identifying levels of risk introduction from North American Strains

	Probability of Occurrence once in 20 Years			
Impact	**Very High**	**High**	**Moderate**	**Low**
Devastating				
Severe		Turkey Breeding	Laying Hen Broiler Breeder	Broiler Chicken
Noticeable		Turkey Commercial	Layer Breeder	Geese
Minor				Backyard Mix

5.1 Summary

The classic route for an outbreak of highly pathogenic avian influenza is for a low pathogenic strain to jump from wild waterfowl into poultry. The virus then cycles and mutates into in a highly pathogenic form. While the speed of mutation is unpredictable, the virus has a history of becoming highly pathogenic only in large commercial flocks of chickens, turkeys and other gallinaceous birds. The virus rarely or never mutates into this deadly form in domesticated waterfowl or small poultry flocks. The economic impact of an outbreak of avian influenza tends to be higher for laying hen and breeder flocks than for broiler chicken flocks due to the lost income stream when these flocks are eradicated.

5.2 Evidence

Template Assumptions: Wild birds, especially waterfowl and shore birds, are known to harbour influenza viruses. Invariably these are of no virulence for the wild bird and low virulence for domestic poultry if accidentally introduced. The risk to domestic poultry arises when waterfowl origin virus cycles many times after being introduced to a non waterfowl species. These risk conditions allow for the mutation form a LPAI to a HPAI. Therefore age of the flock of turkeys and chickens is a major risk factor for the emergence of new variants.

It appears that low pathogenic avian influenza will not mutate into a highly pathogenic form on farms with less than 8,000 chickens or turkeys on-site. A search of the literature indicates that the index flocks in avian influenza outbreaks are usually quite large (Table 8).

Table 8 Survey of Number of Birds on Index Farms Outbreaks of Highly Pathogenic Avian Influenza

Country	Year	Number of birds on-farm	Type of bird	Reference
Chile	2002	618,000	broiler breeders	Rojas et al, 2002
Australia	1990	111,000	various chickens	Morgan and Kelly, 1990
Australia	1997	~ 36,000	laying hens	Selleck et al, 2003
England	1963	30,600	turkeys	Wells, 1963
Netherlands	2003	28,000	laying hens	Elbers et al, 2004
Canada	2004	18,000	broiler breeders	CFIA, 2004
England	1991	8,000	turkeys	Alexander et al, 1993

Note index cases in avian influenza endemic areas and farms which also act as live bird markets or dealers have not been included.

The 2003 outbreak of avian influenza in the Netherlands HPAI A/Chicken/Netherlands/01/03 (H7N7) is most likely to have arisen after Dutch poultry became infected with a LPAI virus of H7 subtype of wild bird origin that mutated in domestic poultry into an HPAI virus and produced clinical disease (Stegeman et al 2004).

In developed countries without extensive live bird markets, highly pathogenic avian influenza is a disease of large commercial farms and not backyard flocks. In the 1999 to 2001 outbreak of HPAI H7N1 in Italy, there were 388 commercial flocks and only 25 backyard flocks infected. In the HPAI H7N3 outbreak in Canada in 2004, 28 commercial flocks and 10 backyard flocks were infected with the disease appearing to spread from the large to the small flocks. In the Netherlands outbreak there is no evidence that keeping birds indoors did anything to stop the virus (Stegemen et al 2004, Thomas 2005).

Extensive testing after an outbreak of HPAI in a commercial flock in Australia revealed no infection in surrounding backyard flocks (Selleck et al 2003). A similar experience was reported from Pennsylvania with a lower path H7N2 (Dunn et al 2003)

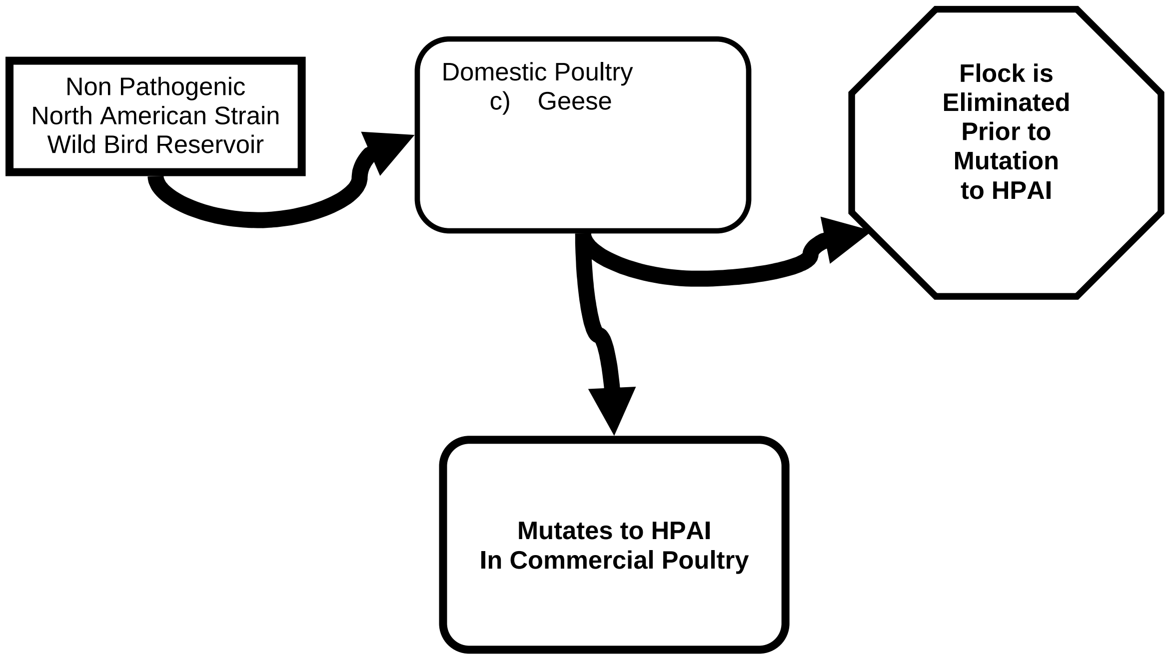
In some cases newly introduced field strain viruses mutate very rapidly. In the 2004 outbreak of avian influenza in British Columbia both LPAI and HPAI H7N3 from birds in the first barn identified as infected. On the second barn on the same premises only HPAI-H7N3 was isolated.

Low pathogenic strains can circulate for considerable periods of time in domestic poultry without significant mutation. A LPAI H7 avian influenza virus circulating in the northeastern United States has been slowly mutating for over 10 years. Viruses isolated between 1994 and 2002 from live-bird markets (LBMs) in and from three outbreaks in commercial poultry have been characterized. Phylogenetic analysis of the HA and NA genes demonstrates that the isolates from commercial poultry were closely related to the viruses resident in the LBMs. Also, since 1994, two distinguishing genetic features have appeared in this lineage. Analysis of the HA cleavage site amino acid sequence, a marker for pathogenicity in chickens and turkeys, shows a progression toward a cleavage site sequence that fulfills the molecular criteria for highly pathogenic AI (Spackman 2003).

The 2002 Texas H5N3 isolate recently analyzed (Lee et al 2004) had a unique haemagglutinin cleavage site sequence of REKR/G (other recent isolates have the typical avirulent motif, RETR/G). Furthermore, this isolate had a 28 amino acid deletion in the stalk region of the neuraminidase protein, a common characteristic of chicken adapted influenza viruses, and may indicate that this virus had actually been circulating in poultry for an extended period of time before it was isolated. In agreement with genetic evidence, the Texas H5N3 isolate replicated better than other H5 isolates in experimentally infected chickens. The outbreak in Texas with a more chicken-adapted H5N3 virus underscores the importance of ongoing surveillance and control efforts regarding the H5 subtype AI virus in the US.

Some period of time must elapse between when a LPAI of water bird origin is introduced into domestic poultry and the point where a HPAI emerges in poultry. Between 1979 and 2002 there have been 108 known introductions of water bird origin LPAI into Minnesota poultry involving 1100 flocks, mostly outdoor reared turkey. Of the 108 isolates 20 have been H5 or H7. Control was implemented by quarantine followed by depopulation at the end of production (not immediate destruction). No government compensation has been paid out, no spread of AI to neighboring states has occurred and no destruction of healthy birds has been required (Halvorson 2003).

SECTION 6 - Risk Pathway 1c Wild birds to Domestic Geese



Risk Pathway 1c

Figure12 Classical pathway of introduction of influenza-A into domestic geese and emergence of Highly Pathogenic Avian influenza.

6.1 Summary

Influenza-A viruses rarely cause disease in ducks and geese. Pathogenicity of Influenza in waterfowl has only been identified 3 times A/tern/South Africa/61 (H5N3) (Becker 1966); domestic geese and Muscovi Ducks in Italy in 1999-2000 (H7N1) (Capua et al 2001); and the recent outbreaks in Southern China (Hulse-Post et al 2005, Kishida et al 2005). Recent H5N1 isolates from southern China may be non-pathogenic for migratory ducks but retain high pathogenicity for other poultry (Webster et al 2006, Perkins et al 2002).

Domestic geese are highly resistant to low pathogenic forms of avian influenza and the virus does not appear to have ever mutated to the highly pathogenic form while in a domestic goose flock (with one possible exception). A North American wild bird H5 or H7 introduction into commercial geese is a significant risk only if the goose flock can transmit the virus to chickens or turkeys. If a highly pathogenic form (eg Z genotype H5N1) is introduced from other poultry or wild waterfowl, high mortality would not likely occur. The most likely scenario would be a low level of sick and dead birds and a limited amount of shed of the virus.

6.2 Evidence

During the summer and early fall of 1996, an outbreak of disease with 40% morbidity occurred on a goose farm in Guangdong Province, China and attracted little international attention. At least two influenza A (H5N1) viruses from sick birds were isolated in embryonated eggs. The pathogenicity of one of these isolates, A/Goose/Guangdong/1/96, was evaluated in experimentally inoculated geese and the virus caused illness and death. This virus has also caused illness and death in chickens experimentally inoculated by the intravenous route. The hemagglutinin (HA) gene of this virus was genetically similar to those of the human pathogen H5N1 isolated in Hong Kong in 1997 (Tang et al 1998, Xu 1999).

Since 1996 it has been demonstrated that many genetically and antigenically distinct sublineages of H5N1 virus have become established in poultry in different geographical regions of Southeast Asia, indicating the long-term endemnicity of the virus. The isolation of H5N1 virus from apparently healthy migratory birds in southern China also supports this hypothesis. The H5N1 influenza virus, has continued to spread from its established source in southern China to other regions through transport of poultry and wild bird migration. Domestic poultry tested positive for H5N1 virus in 16 of the past 18 months between January 1, 2004 and June 30, 2005.

H5N1 virus was most frequently isolated from healthy migratory ducks and geese (isolation rates, 1.8% and 1.9%, respectively), followed by minor poultry (0.46%) and chickens (0.26%). H5N1 virus has persisted in various types of poultry in the markets of southern China, for almost 10 yr and has been repeatedly introduced into neighboring (e.g., Vietnam) and distant (e.g., Indonesia) regions, establishing ‘‘colonies’’ of H5N1 virus throughout Asia (Chen 2006).

The identification of regionally distinct sublineages of Asian H5N1 contributes to the understanding of the mechanism for the perpetuation and spread of H5N1, providing information that is directly relevant to control of the source of infection in poultry. It points to the necessity of surveillance that is geographically broader than previously supposed and that includes H5N1 viruses of greater genetic and antigenic diversity (Chen 2006).

If domestic or wild geese become infected with the Asian H5N1 strain of highly pathogenic avian influenza, sick or dead birds may be observed. Research has demonstrated that in geese the virus tends to localize in the brain causing nervous signs and sometimes high mortality (Perkins and Swayne 2002; Shortridge et al 1998). In Italy during the 1999 to 2000 outbreak of HPAI H7N1, veterinarians noticed in small, mixed flocks of chickens, turkeys, geese and ducks that waterfowl were rarely affected by one case of mortality in geese was observed (Capua and Mutinelli 2001). In most cases, highly pathogenic forms of avian influenza have caused no visible sickness, only mild lesions, and no or limited viral shed in ducks.

SECTION 7 - Route 2 Introduction of Zoonotic Avian Influenza from Asia

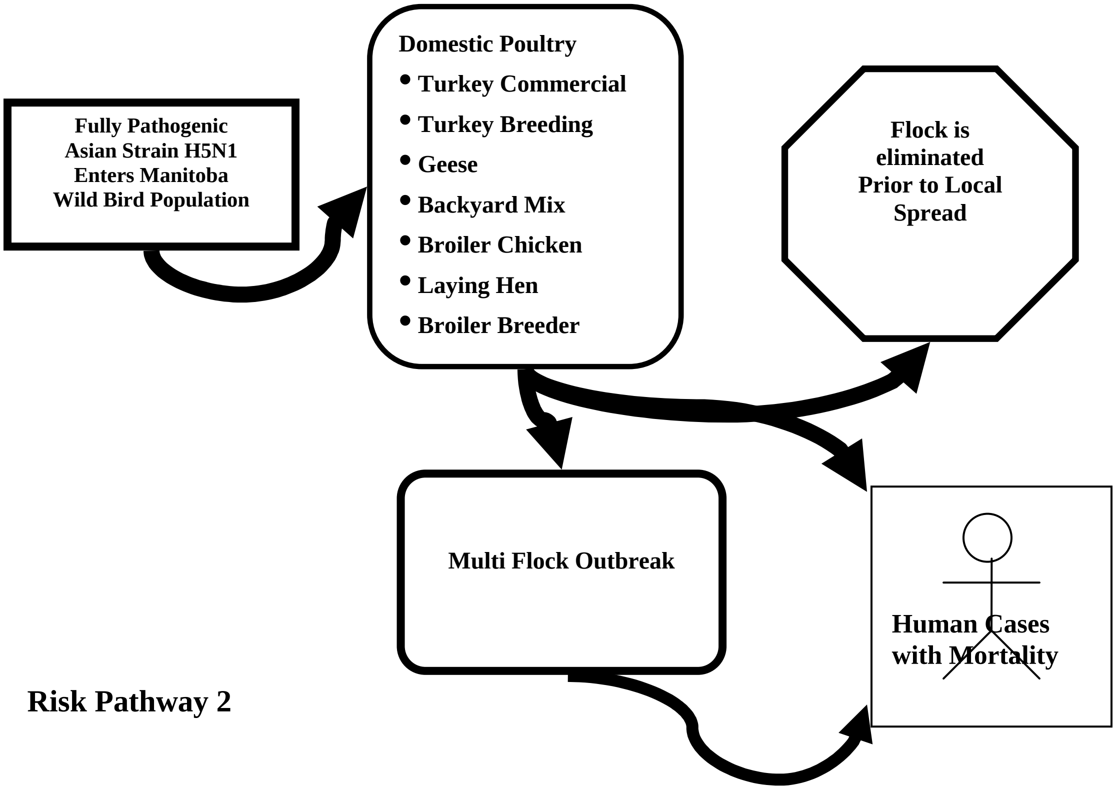


Figure 13 Risk pathway for introduction of zoonotic avian influenza from Asia.

Table 9. Matrix identifying levels of risk Asian H5N1

	Probability of Occurrence Within 20 Years			
Impact	**Very High**	**High**	**Moderate**	**Low**
Devastating			Multi-Flock Outbreak	Human Disease
Severe		Single Flock Outbreak		
Noticeable				
Minor				

7.1 Summary

The emergence of highly pathogenic H5N1 avian influenza in Asia and its potential spread by wild waterfowl is a new threat. It offers the risk that instead of introducing low pathogenic virus, wild waterfowl can introduce a virus that is already “fully weaponized” to poultry flocks. As it emerges from the wild, this strain is capable of killing large numbers of animals. In its present form, however, the virus has demonstrated a very limited capability to infect small numbers of people. For even a few human cases to occur, it appears that many flocks must be infected and large numbers of people must come in close contact with the feathers and manure of infected birds.

7.2 Evidence

There is a potential risk that HPAI subtype H5N1 might be carried along migration routes of wild water birds to densely populated areas in the south Asian subcontinent and along migratory flyways to Africa and Europe. Recent outbreaks of HPAI in Russia and Kazakhstan (August, 2005) may be suggestive of the role of wild birds in the epidemiology of HPAI. The complex overlapping of major flyways (Fig 1) and the lack of information on migratory species potentially involved in AI disease spread make simple association of wild bird flyways with outbreaks of AI difficult. The H5N1 form of the avian influenza virus has been confirmed in European Union countries Greece, Italy, Germany, Austria, France, Slovenia, Hungary, Romania and Croatia.

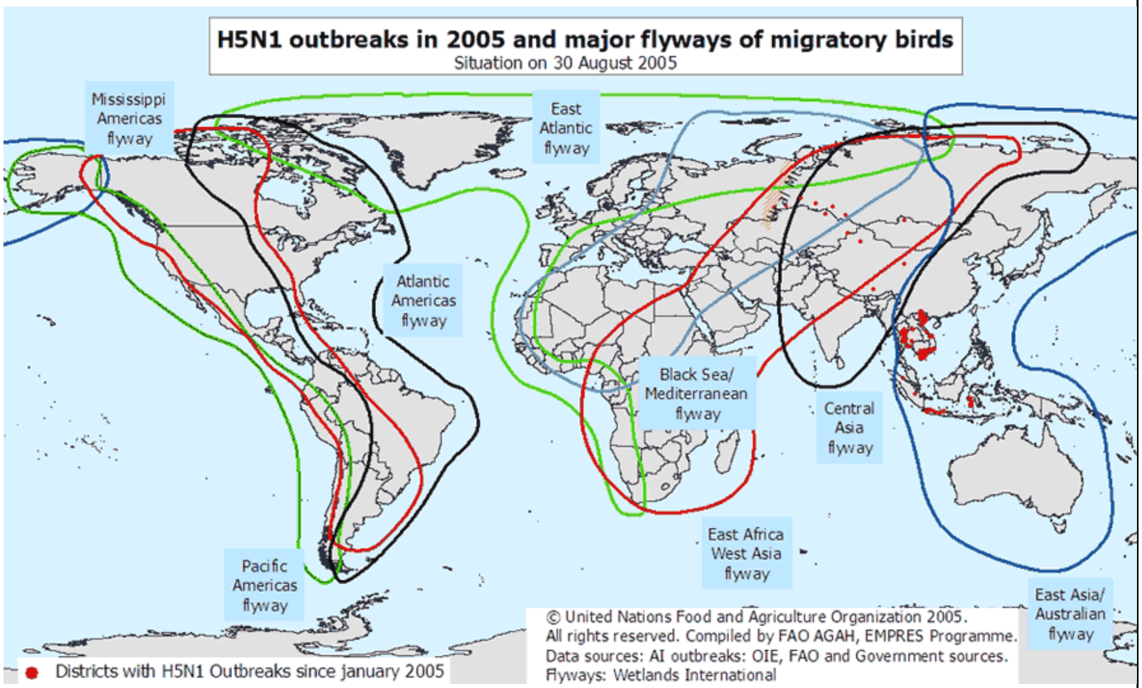


Figure 14 Map from http://www.fao.org/ag/againfo/subjects/en/health/diseases-cards/avian_HPAIrisk.html

Highly Pathogenic Avian Influenza (HPAI), subtype H5N1 has been occurring in poultry in Southeast Asia since 2003. Until recently, the outbreaks were restricted to Indonesia, Viet Nam, Thailand, Lao PDR, Cambodia and China. But since late July 2005, HPAI H5N1 has expanded in a north-westerly direction.

However, it is plausible that HPAI H5N1 virus could spread from Siberia to the circumpolar ecosystem and come into contact with birds originating from the North American Flyways (Green line-Black line overlap Figure 14). The exact risk will likely depend on the identification of specific migratory species that carry H5 viruses without suffering the disease, and knowledge of their resting areas and wintering grounds combined with the location and biosecurity infrastructure of existing production poultry systems and husbandry. The East Atlantic flyway has considerable overlap with the Atlantic Americas Flyway and now that Nigeria is infected in commercial poultry and wild swans are infected in Hungary/Central Europe there is reason to believe that the East Atlantic flyway will be involved in disease transmission in the spring migration.

Mongolia reported the death of some 90 migratory birds at two lakes in the northern part of the country in early August, 2005. Influenza A virus subtype H5 was isolated from samples taken from dead wild water birds. From April to June, 2005 more than 6000 migratory birds have been reported to have died due to H5N1 infection at the Qinghai Lake Nature Reserve in Qinghai Province, China (Liu et al 2005, Chen et al 2005). This included bar-headed geese *Anser indicus*, great black-headed gulls *Larus ichthyaetus*, brown-headed gulls *Larus* *brunnicephalus*, ruddy shelducks *Tadorna ferruginea* and great cormorants *Phalacrocorax carbo*. In China (Tibet), the death of 133 breeding hens was reported and H5N1 was isolated from samples from these birds.

These new outbreaks suggest that this highly pathogenic H5N1 virus is spreading progressively north-westwards and not restricted to the Southeast Asian focus, where the outbreaks of AI started in mid-2003. In Russia and Kazakhstan, contact between domestic poultry and wild waterfowl at open water reservoirs is considered the primary source of infection for poultry. Similar experience occurred in introduction in Germany and western Europe where the Asian strain was first identified in migratory birds on islands in the Baltic Sea and later in commercial poultry in France (http://www.hpa.org.uk/infections/topics_az/influenza/avian/avian_flu_news.htm)

All of the H5N1 viruses isolated from wild birds during the 2003-2004 outbreaks were from dead or dying birds which were located in the vicinity of infected poultry flocks or recently contaminated premises. It appears that some form of the currently circulating strain of H5N1 is also highly pathogenic to wild birds including ducks, as can be shown from the isolation of the virus from numerous dead wild birds and disease outbreaks in bird parks and zoos. In 2004, H5N1 was identified in several species of dead and dying birds including various wild birds in Thailand, magpies in Korea, crows in Japan, a zoo collection in Cambodia and a single heron and peregrine falcon in Hong Kong (Table 10).

Table 10 Spillover from Commercial Poultry to Wild Birds South East Asia

COUNTRY	SPECIES	TYPE AI	DATE
Hong Kong	Peregrine Falcon and Grey Heron	H5N1	Jan 2004
Cambodia	Wild birds in a zoo collection	H5N1	Feb 2004
Japan	Crows	H5N1	Mar 2004
Korea	Magpies	H5N1	Mar 2004
Thailand	Pigeons, Open-Bill Storks, Little Cormorant, Red-collar Dove, Scaly Breasted Munia, Black Drongo	H5N1	Dec 2004
China	Grey Heron	H5N1	Dec 2004
China	Bar-headed geese, Great black-headed gulls, Brown-headed gulls. Ruddy shelducks and Great cormorants	H5N1	Apr 2005
Mongolia	Bar-headed geese and Whooper swan near lake.	Influenza A subtype H5	Aug 2005
Russia (Siberia)	Wild birds	H5N1	Aug 2005
Kazakhstan	Wild birds	H5N1	Aug 2005

In late 2005 winter 2006 geographic spread to Germany, France and Egypt-Nigeria appears to strongly support the transmission of disease in migratory birds while the Nigerian outbreaks appear to be due to commercial birds and poultry products from Egypt.

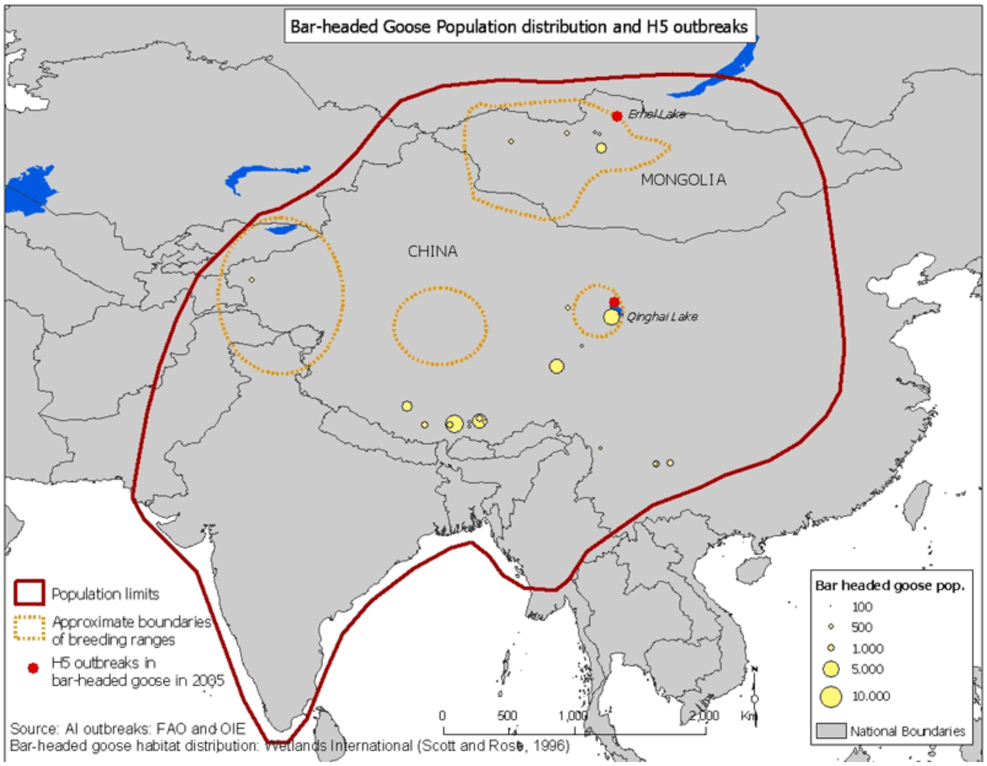


Figure 15 Bar headed goose (*Anser indicus*) range incorporates most of the early spread of Asian strain H5N1 HPAI in the summer of 2005.

Southward migration for the northern-breeding Anatidae (swimming birds having heavy short-legged bodies and bills with a horny tip: swans; geese; ducks) starts in July and increases throughout the following months. Most birds would have reached their winter range sometime between November and December. The migration takes them north to reproduction areas at the end of winter, beginning of spring. The winter of 2003-2004 when most of the outbreaks in South East Asia occurred, was when migratory bird densities in South East Asia were at their peak. This appears to implicate wild birds as a possible source for the infection. However, the pattern of the HPAI outbreaks does not coincide with migratory pathway of wild birds for all countries. It is important to note that, if introduced by migratory birds alone, outbreaks of avian influenza would also be expected to have occurred, for example, in Taiwan and the Philippines, or even at the extreme range of the flyway in parts of eastern Australia and New Zealand, if shore birds are shown to be reservoirs (shore birds and wading birds belong to the classification order Charadiformes).

Many duck species identified to carry avian influenza viruses, winter in large numbers in Taiwan and the Philippines as well as in areas in Southern Asia. Migrating birds also tend to bypass mainland China, where numerous HPAI outbreaks have occurred, in favour of traveling down the coastline or across western China to avoid the Himalayan Mountains. Furthermore, the timing of the

Indonesian and Malaysian outbreaks occurred outside the times when migratory birds would have been present in the countries. Therefore, unexplained factors such as unrecorded commercial bird movement could possibly be at play in the dissemination of AI viruses.

There remains a body of data and analysis missing on the collection and detection of HPAI viruses in wild birds. The 1986 Mexican H5N2 was identified in a Connecticut Plover almost 2 years prior to the strain emerging as a pathogen in poultry. Surveillance in Charadiformes is difficult as they do not congregate in large numbers to allow for strategic sampling. Finding HPAI viruses in wild birds may be a rare event, but if the contact with susceptible species occurs it can cause an outbreak at the local level or in distant areas.

*7.3 Current International Scientific Recommendations Asian H5N1**

To prevent further spreading of Asian H5N1, surveillance in domestic poultry as well as in wild birds should be strengthened in countries at immediate risk, especially along migrating bird routes. Resources should be focused on the reduction of close contacts between humans, domestic poultry and wildlife through better management practices and improved biosecurity practices in poultry production enterprises, especially those that are small and 'open-air'- where domestic poultry and waterfowl are allowed to mingle with wild birds.

The control of avian influenza infection in wild bird populations at this stage, is not feasible - from a logistical, environmental and biodiversity point of view. Indiscriminate culling of wild migratory bird populations would be ineffective in preventing further spread of avian influenza and their hunting would likely cause dispersion of the birds.

Monitoring, sampling and analysis of the viral subtypes of avian influenza found in wild birds need to be done in order to fully understand their role in the propagation and spread of highly pathogenic avian influenza viruses. Multidisciplinary research is required that brings in the competencies of veterinarians, wildlife specialists, ornithologists, virologists, molecular biologists and other resource avenues.

*Reference: http://www.fao.org/ag/againfo/subjects/en/health/diseases-cards/avian_HPAIrisk.html

SECTION 8 - Route 3 Risk of AI Movement through Pigs

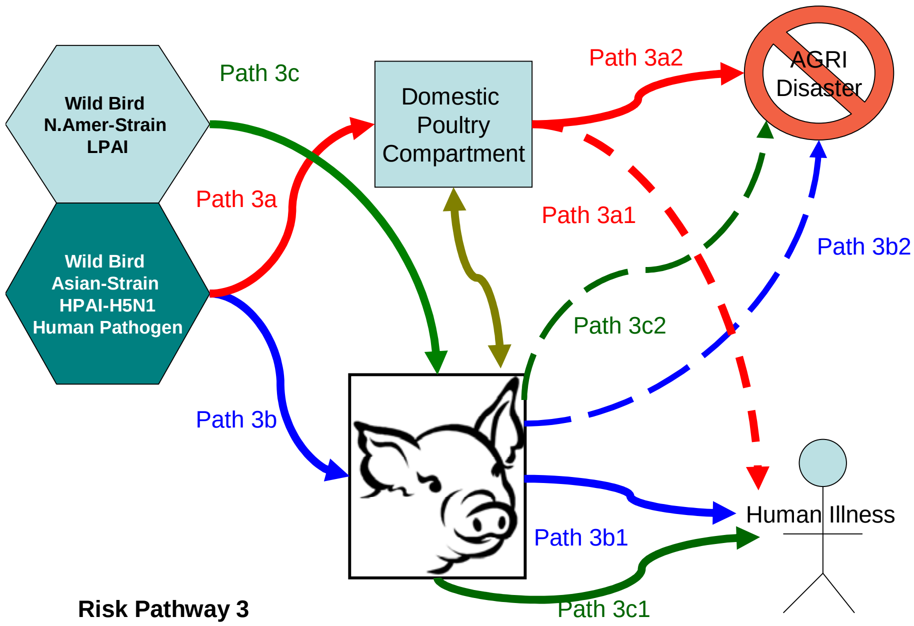


Figure 16 Risk pathway for introduction of zoonotic or HP avian influenza from recombination in pigs in Manitoba.

8.1 Summary

Pigs are permissive to both human and avian influenza viruses and have been proposed to be an intermediate host for the genesis of pandemic influenza viruses through reassortment or adaptation of avian viruses.

Pigs have not yet been implicated in the epidemiology of H5N1 (southeast Asian) strain of avian influenza. Because they are susceptible to both human and avian strains of the virus, they remain as a potentially highly vulnerable population of animals.

Table 11. Matrix identifying levels of risk Swine Involvement

	Vulnerability to Threat (one incident in 20 Years)			
Impact of Loss	**Very High**	**High**	**Moderate**	**Low**
Devastating			Asian H5N1 found in pigs	Swine Origin Human Pandemic
Severe			Swine Origin Human Pathogen (non Pandemic)	
Noticeable		Swine flu in poultry		
Minor				Swine Origin Horse/Dog Pathogen

8.2 Evidence

If multiple domestic species become involved the possible scenarios are much worse for agriculture and human health. If Asian strain H5N1 were to be identified in the Manitoba Swine complex multiple repercussions could be expected including possible closure of the US border to live swine and pork, worker refusal to enter swine buildings, logistic problems in dealing with surplus animals and public perception of danger.

Virus infection of pigs does have human health implications although recent outbreaks of pig-adapted viruses have not been associated with human deaths. The movement of low pathogenic strains or the H5N1 Asian highly pathogenic strain of avian influenza from wild birds to pigs has not been associated with high mortality in pig populations in Asia. Farm management is significantly less intensive with smaller herd sizes in pork production in Asia.

Significant species barrier exists between human and avian Strains of Influenza A. During the course of a single-cycle human infection, human adapted viruses preferentially infected nonciliated cells, whereas avian viruses as well as the egg-adapted human virus variant with an avian virus-like receptor specificity mainly infected ciliated cells. This pattern correlated with the predominant localization of receptors for human viruses (2-6-linked sialic acids) on nonciliated cells and of receptors for avian viruses (2-3-linked sialic acids) on ciliated cells. These findings suggest that although avian influenza viruses can infect human airway epithelium, their replication may be limited by a nonoptimal cellular tropism (Matrosovich et al 2004)

During infection, influenza-A viruses attach to the host epithelium via the haemagglutinin protein. Avian origin haemagglutinins preferentially attach to the 2.3-sialic acid receptors on the respiratory and gut epithelium of birds. Human origin haemagglutinins preferentially attach to the 2.6-sialic acid receptors on the lower respiratory epithelium of people. Pigs have both the 2.3-sialic acid receptors and the 2.6-sialic acid receptors allowing them to be infected by both human and avian adapted strains of influenza. In addition the 2.3-sialic acid (bird type) receptors are also found on the human conjunctiva (eye), and on the upper ciliated portion of the respiratory column (large airways excluding lung) (Matrosovich et al 2004). The human infections in The Netherlands 2003 and the British Columbia 2004 bird outbreaks were primarily conjunctivitis.

Animals act as reservoirs for this influenza virus and research indicates the influenza virus often originates in the intestines of aquatic wildfowl. The virus is shed into the environment, which in turns infects domestic poultry, which in turn infects mammalian hosts. These animals, usually pigs, act as a transformer or converters; creating a strain that can more readily infect humans. These reassortant strains may have potential to cause pandemic influenza in humans. Therefore swine can be infected with both avian and human influenza A viruses and serve as a source for infection for a number of species as the incidents of direct infection from birds to humans have been rare. Increased human habitation near poultry and swine raising facilities pose greater influenza outbreak risk. It was this combination of environmental factors that may have contributed to the greatest pandemic of recent times, and, moreover, similar conditions exist throughout Southeast Asia today. (Hollenbeck 2005, van Eijk et al 2004).

Pigs serve as major reservoirs of H1N1 and H3N2 influenza viruses which are endemic in pig populations world-wide and are responsible for one of the most prevalent respiratory diseases in pigs. The maintenance of these viruses in pigs and the frequent exchange of viruses between pigs and other species is facilitated directly by swine husbandry practices, which provide for a continual supply of susceptible pigs and regular contact with other species, particularly humans. The pig has been a contender for the role of intermediate host for reassortment of influenza A viruses of avian and human origin since it is the only domesticated mammalian species which is reared in abundance and is susceptible to, and allows productive replication of, avian and human influenza viruses. This can lead to the generation of new strains of influenza, some of which may be transmitted to other species including humans. This concept is supported by the detection of human-avian reassortant viruses in European pigs with some evidence for subsequent transmission to the human population. Following interspecies transmission to pigs, some influenza viruses may be extremely unstable genetically, giving rise to variants which could be conducive to the species barrier being breached a second time. Eventually, a stable lineage derived from the dominant variant may become established in pigs. Genetic drift occurs particularly in the genes encoding the external glycoproteins, but does not usually result in the same antigenic variability that occurs in the prevailing strains in the human population. Adaptation of a 'newly' transmitted influenza virus to pigs can take many years. Both human H3N2 and avian H1N1 were detected in pigs many years before they acquired the ability to spread rapidly and become associated with disease epidemics in pigs (Brown 2000, Riedel 2006, Jang-Pin Liu 2006).

Swine influenza viruses can transmit directly to humans and cause disease. Two human influenza A viruses (A/Netherlands/5/93 [H3N2] and A/Netherlands/35/93 [H3N2]) that caused influenza in children in The Netherlands in 1993 were human-avian reassortments that were generated and currently still are circulating in European swine (Claas et al 1994, 2000).

Prospective virological surveillance carried out between March 1998 and June 2000 in Hong Kong, Special Administrative Region, People's Republic of China, on pigs imported from southeastern China, provides the first evidence of interspecies transmission of avian H9N2 viruses to pigs and documents their cocirculation with contemporary human H3N2 (A/Sydney/5/97-like, Sydney97-like) viruses. All gene segments of the porcine H9N2 viruses were closely related to viruses similar to chicken/Beijing/1/94 (H9N2), duck/Hong Kong/Y280/97 (H9N2), and the descendants of the latter virus lineage. Phylogenetic analysis suggested that repeated interspecies transmission events had occurred from the avian host to pigs. The Sydney97-like (H3N2) viruses isolated from pigs were related closely to contemporary human H3N2 viruses in all gene segments and had not undergone genetic reassortment. Cocirculation of avian H9N2 and human H3N2 viruses in pigs provides an opportunity for genetic reassortment leading to the emergence of viruses with pandemic potential (Periris et al 2001).

Swine can be directly infected with wholly human Influenza isolates. Previous to 1998, a swine-adapted H1N1 was ubiquitous in the U.S. swine herd and parts of Canada. Since 1998, H3N2 viruses have caused epizootics of respiratory disease in pigs throughout the major swine production regions of the U.S. Sequence analysis of four H3N2 viruses isolated from pigs in the Midwestern U.S. between March 1998 and March 1999, a H3N2 viruses recovered from a piglet in Canada in January 1997 and from a pig in Colorado in 1977. Phylogenetic analyses demonstrated that the 1977 Colorado and 1997 Ontario isolates are wholly human influenza viruses. However, the viruses isolated since 1998 from pigs in the Midwestern U.S. are reassortant viruses containing hemagglutinin, neuraminidase and PB1 polymerase genes from human influenza viruses, matrix, non-structural and nucleoprotein genes from classical swine viruses, and PA and PB2 polymerase genes from avian viruses. The HA proteins of the Midwestern reassortant swine viruses can be differentiated from those of the 1995 lineage of human H3 viruses by 12 amino acid mutations in HA1. In contrast, the Sw/ONT/97 virus, which did not spread from pig-to-pig, lacks 11 of these changes (Karasin 2000).

Phylogenetic analyses of the polymerase B1 (PB1) genes showed that interspecies transmission from humans to pigs has happened multiple times in pigs in Southern China. All 72 H1N1 isolates were of porcine origin characteristic of classical porcine H1N1 influenza virus. Analysis of 624 genes of porcine influenza viruses from Southern China failed to detect any evidence for avian influenza virus genes. This contrasts to what is currently found in Europe, where the majority of porcine influenza virus isolates are of avian origin (Shu et al 1994).

Prospective virological surveillance carried out between March 1998 and June 2000 in Hong Kong, Special Administrative Region, People's Republic of China, on pigs imported from southeastern China, provides evidence of interspecies transmission of avian H9N2 viruses to pigs and documents their cocirculation with contemporary human H3N2 (A/Sydney/5/97-like, Sydney97-like) viruses. Unlike the recent reassortant H3N2 viruses isolated from pigs in the North American continent, viruses isolated in this present study had not undergone reassortment and are similar in all gene segments to contemporary human H3N2 viruses. These human H3N2 viruses have not yet undergone reassortment with porcine viruses. The H9N2 viruses are still in the process rapid evolution in the avian host and now have crossed to a new host—the pig. Unlike H5N1/97 viruses, the HA of these H9N2 viruses would be predicted to already have affinity to bind to the sialyl-oligosaccharides found on human cells. In the context of a human population immunologically naive to the H9 antigen, such a virus would pose a significant pandemic threat. (Peiris et al 2001).

Currently the zoonotic risk from H9 class of influenza is not being emphasized or has been overshadowed by the H5N1activity world wide. H9N2 subtype avian influenza viruses (AIVs) are widely distributed in avian species and were isolated from humans in Hong Kong and Guangdong province. H9N2 viruses were isolated from nasopharyngeal aspirate specimens collected from two children who were hospitalized with uncomplicated, febrile, upper respiratory tract illnesses in Hong Kong during March 1999 (Uyeki et al 2002). Novel influenza viruses have the potential to initiate global pandemics if they are sufficiently transmissible among humans. This particular strain appears to be adapted to parrot family of birds which is a rare adaptation (Mase et al 2001).

In Hong Kong, H9N2 was the most prevalent influenza virus subtype in the live-poultry markets between 2001 and 2003. Viruses of all six genotypes of H9N2 recently found were able to replicate in chickens and mice without adaptation. The infected chickens showed no signs of disease, but representatives of two viral genotypes were lethal to mice. Three genotypes of virus replicated in the respiratory tracts of swine, which shed virus for at least 5 days. These results show an increasing genetic and biologic diversity of H9N2 viruses in Hong Kong and support their potential role as pandemic influenza agents (Choi et al 2004).

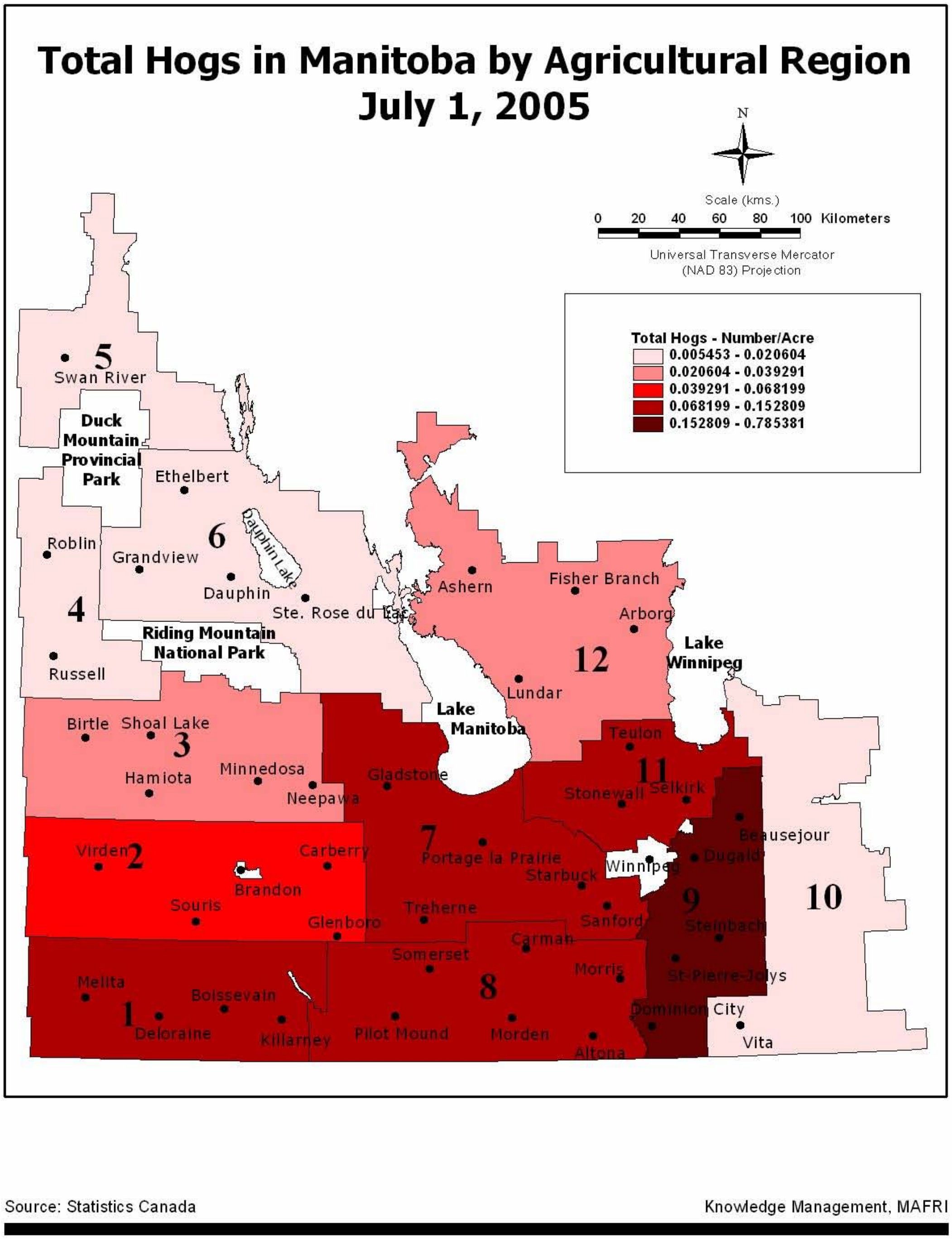


Figure17 Swine density is very low compared to similar regions in south-east Asia. Swine are concentrated in the same municipalities as are poultry production South and East of Winnipeg. Many more people have daily contact with swine than with commercial chickens, which are more easily handled by automatic equipment.

SECTION 9 - Route 4 Live Bird Market Involvement

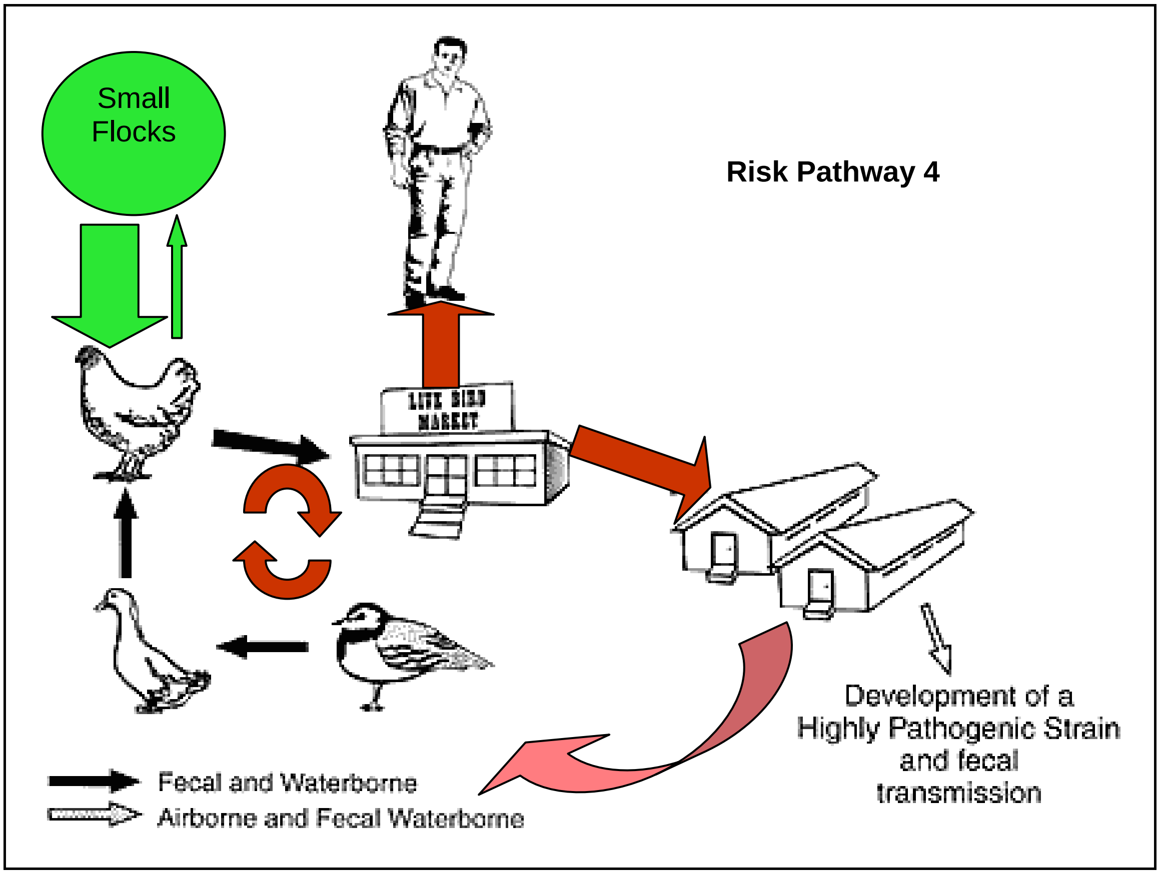


Figure 18 Live bird markets have been implicated in the dissemination of various strains of Avian Influenza in Hong Kong in 1997, In Texas in 2004 and in the NE-Seaboard Pennsylvania and the Delaware peninsula in the United States.

Live Bird Markets

Table 12. Matrix identifying levels of risk

	Probability of Occurrence 1/20 years			
Impact	**Very High**	**High**	**Moderate**	**Low**
Devastating				
Severe				
Noticeable				
Minor				No LBM's

There are no Live Bird Markets in Manitoba this section is included to facilitate understanding of the global situation with Avian Influenza.

9.1 Summary

Live bird markets are reservoirs of avian influenza that have been created and maintained by human activity. These markets also greatly increase the contact between people and the feathers and manure of infected birds.

No live birds operate in Manitoba. The auction marts and live birds shows in the province are too small and occur too infrequently infrequent to act as a reservoir of the virus.

9.2 Evidence

Live-animal markets (wet markets) provide a source of vertebrate and invertebrate animals for customers in tropical and subtropical regions of the world. Wet markets sell live poultry, fish, reptiles, and mammals of every kind. Live-poultry markets (mostly chicken, pigeon, quail, ducks, geese, and a wide range of exotic wild-caught and farm-raised fowl) are usually separated from markets selling fish or red-meat animals, but the stalls can be near each other with no physical separation. Despite the widespread availability of affordable refrigeration, many Asian people prefer live animals for fresh produce. Wet markets are widespread in Asian countries and in countries where Asian people have migrated.

Live-poultry markets were the source of the H5N1 bird-influenza virus that transmitted to and killed six of 18 people in Hong Kong. The isolation of severe acute respiratory syndrome (SARS) coronavirus (CoV) from Himalayan palm civets (Paguna larvata) in wet markets in Shenzen, southern China. Serological evidence for SARS CoV in human beings working in these markets, taken together with the earliest cases of SARS in restaurant workers, supports the contention of a potential zoonotic origin for virus evolution in live animals (Kan et al 2005). Knowledge of the ecology of influenza in wet markets can be used as an early-warning system to detect the reappearance of SARS or pandemic influenza (Webster 2004)

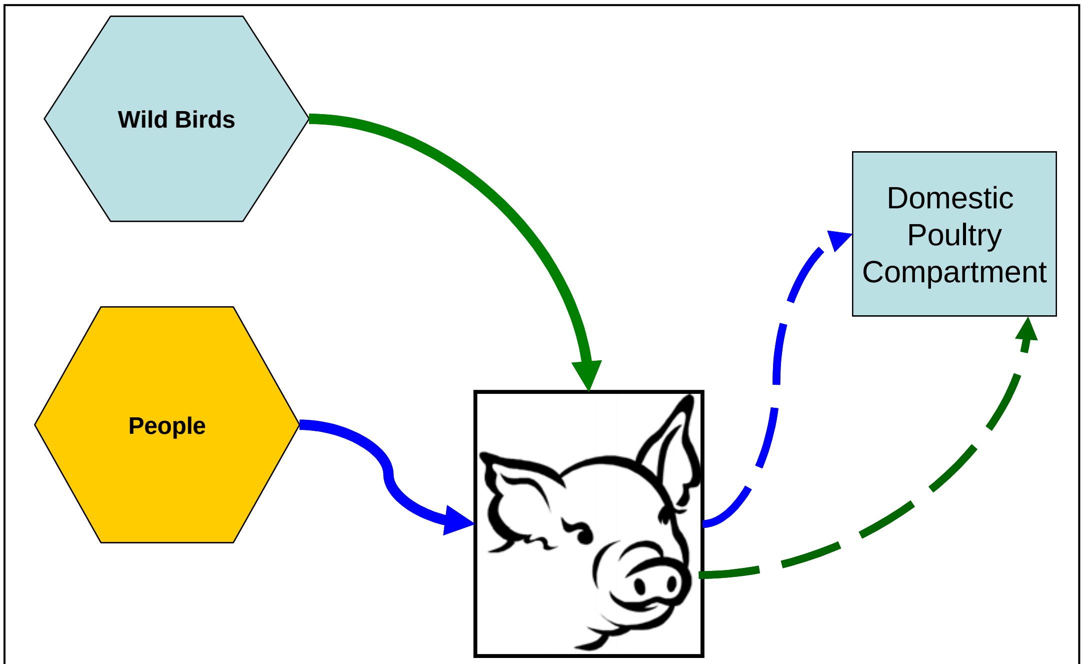
The hemagglutinin (HA) and neuraminidase (NA) genes of H7 avian influenza virus (AIV) isolated between 1994 and 2002 from live-bird markets (LBMs) in the northeastern United States and from three outbreaks in commercial poultry have been characterized. Phylogenetic analysis of the HA and NA genes demonstrates that the isolates from commercial poultry were closely related to the viruses circulating in the LBMs. Also, since 1994, two distinguishing genetic features have appeared in this AIV lineage: a deletion of 17 amino acids in the NA protein stalk region and a deletion of 8 amino acids in the HA1 protein which is putatively in part of the receptor binding site. Furthermore, analysis of the HA cleavage site amino acid sequence, a marker for pathogenicity in chickens and turkeys, shows a progression toward a cleavage site sequence that fulfills the molecular criteria for highly pathogenic AIV (Spackman et al 2003, Lee et al 2004, Panigrahy et al 2002, Henzler et al 2003)

While live bird markets operating in New England and Texas are a major reservoir for avian influenza, most of the flocks that supply these markets are free of the disease. In a survey in 2001, of 185 farms that routinely supplied live bird markets in the northeastern U.S., no avian influenza (0%) was found in 2,225 swabs and 2,450 serum samples collected from these farms. In contrast, 20% of the birds tested in the live bird markets were positive for avian influenza (Senne et al 2003; Bulaga et al 2003). It is the on-going introduction of influenza-free birds to the live bird markets and their mixing with birds already infected in the markets that allows avian influenza to persist.

Chickens appear to rarely or never become carriers of avian influenza. It is rare for a flock to break a second time with the same strain and the only known cases are two commercial laying hen flocks in Pennsylvania (Davison et al 2003, Dunn et al 2003). When chickens were infected experimentally with four strains of H7N2 avian influenza, the birds shed virus for two weeks or less and within another two weeks these birds would not spread the disease to other susceptible birds (Lu et al 2003).

The auction markets and live bird shows that do occur in Manitoba do not meet the epidemiological criteria for them to become reservoirs of the disease. To act as a reservoir, an auction market must remain open on an almost constant basis and must accept large numbers of susceptible birds on an almost weekly basis.

SECTION 10 - Route 5 Risk of AI Movement from Pigs to Poultry



Risk Pathway 5

Table 13. Matrix identifying levels of risk

	Probability of Occurrence 1/20 years			
Impact	**Very High**	**High**	**Moderate**	**Low**
Devastating				
Severe				
Noticeable		Swine Adapted Influenza in Poultry		
Minor				

10.1 Summary

Currently the primary risk to commercial poultry is the presence of human/swine adapted H3N2 circulating in Manitoba swine production. The virus can have a large impact on turkey breeder flocks but vaccinations are now available that appear to provide significant protection. There are no signs that the virus has spread to or caused problems in meat or egg-type chicken flocks. Human adapted influenza viruses currently circulating in swine are a potential public health risk.

10.2 Evidence

In January, 2005, the Manitoba Veterinary Diagnostic Laboratory identified Swine H3N2 for the first time Manitoba swine herds, with cases tracking back to September of 2004. That outbreak affected about 110 pig farms, appeared to subside and has re-emerged this winter. There is an infected swine barn in proximity to the affected turkey breeder farms.

a) On June 20, 2005, Influenza virus was confirmed present in a Manitoba turkey breeder flock, undergoing a significant egg production drop. The private veterinarian involved informed CFIA immediately as suspicions of Avian Influenza outbreaks in poultry are reportable under the federal Health of Animals Act. On June 21st, the BC Lab identified the virus as H3 and it was later confirmed as a Swine Influenza Virus (SIV) H3N2.

b) Four turkey breeder farms operate in the area and all became infected in June, 2005. The egg production drops severe and prolonged and resulted in three of the four flocks being shipped to market. Turkey breeder flocks in other parts of North America have been infected with H3N2 swine influenza with similarly devastating drops in egg production.

c) At the beginning of January, 2006, a flock on one of the four farms involved in the June, 2005 outbreak experienced a significant production drop. Testing at MAFRI's veterinary laboratory has confirmed the presence of H3N2 swine Influenza. Samples have been collected by CFIA for further testing. Egg production has been negatively affected in this flock but not to the extent of the June 1005 outbreak. This flock has been vaccinated with a vaccine designed to help limit the effects of the swine influenza virus.

Interspecies transmission of this virus to turkeys in two geographically distant farms in the United States occurred in 2003. This event is of concern, considering the reassortment capacity of this virus and the susceptibility of turkey to infection by avian influenza viruses. Two H3N2 isolates, A/turkey/NC/16108/03 and A/turkey/MN/764/03, had 98.0% to 99.9% nucleotide sequence identity to each other in all eight gene segments. All protein components of the turkey isolates had 97% to 98% sequence identity to swine H3N2 viruses, thus demonstrating interspecies transmission from pigs to turkeys. The turkey isolates were better adapted to avian hosts than were their closest swine counterparts, which suggest that the viruses had already begun to evolve in the new host. The isolation of swine-like H3N2 influenza viruses from turkeys raises new concerns for the generation of novel viruses that could affect humans (Choi et al 2004).

Other human/swine adapted influenza viruses have been isolated from turkey flocks. Recently an H1N2 influenza virus was isolated from a turkey breeder flock in California with a sudden drop in egg production. Sequence analysis of the virus showed that it was a complex reassortant virus with a mix of swine-, human-, and avian-origin influenza genes. Isolation and identification of the virus required the use of nonconventional diagnostic procedures. The virus was isolated in embryonated chicken eggs by the yolk sac route of inoculation rather than by the typical chorioallantoic sac route. Interpretation of hemagglutination-inhibition test results required the use of turkey rather than chicken red blood cells, and identification of the neuraminidase subtype required the use of alternative reference sera in the neuraminidase-inhibition test. This report provides additional evidence that influenza viruses can cross species and cause a disease outbreak, and diagnosticians must be aware that the variability of influenza viruses can complicate the isolation and characterization of new isolates (Suraez et al 2002).

Recent virus emergence in swine in the United States suggests that North America livestock management practices may be particularly effective at nurturing the evolution of new influenza A variants. In 1998 two distinct variants of H3N2 simultaneously emerged in intensive swine production areas in the US. The North Carolina isolate is the product of genetic reassortment between human and swine influenza viruses (double reassortment) while the Texas, Iowa and Minnesota isolates arose from reassortment of human, swine and avian viral genes (triple reassortment). The hemagglutinin genes of the four isolates were all derived from the human H3N2 virus circulating in 1995 and the genetic events were independent (Zhou et al 2000).

Swine origin influenza can infect domestic poultry and cause clinical disease. In 1998, the Texas triple reassortment H3N2 virus was transmitted to turkeys in two geographically distant farms in the United States in 2003 and in Canada in 2005. This event is of concern, considering the reassortment capacity of this virus and the susceptibility of turkey to infection by avian influenza viruses. Two US isolates H3N2 isolates, A/turkey/NC/16108/03 and A/turkey/MN/764/03, had 98.0% to 99.9% nucleotide sequence identity to each other in all eight gene segments. All protein components of the turkey isolates had 97% to 98% sequence identity to swine H3N2 viruses, thus demonstrating interspecies transmission from pigs to turkeys. The turkey isolates were better adapted to avian hosts than were their closest swine counterpart, which suggests that the viruses had already begun to evolve in the new host. The isolation of swine-like H3N2 influenza viruses from turkeys raises new concerns for the generation of novel viruses that could affect humans (Choi 2004, Webby 2000).

Infection of turkeys with swine H1N1 viruses has been documented on several occasions. This report documents the isolation of an H1N2 influenza virus from a turkey breeder flock with a sudden drop in egg production. Sequence analysis of the virus showed that it was a complex reassortant virus with a mix of swine-, human-, and avian-origin influenza genes. A swine influenza virus with a similar gene complement was recently reported from pigs in Indiana. Isolation and identification of the virus required the use of nonconventional diagnostic procedures. The virus was isolated in embryonated chicken eggs by the yolk sac route of inoculation rather than by the typical chorioallantoic sac route. Interpretation of hemagglutination-inhibition test results required the use of turkey rather than chicken red blood cells, and identification of the neuraminidase subtype required the use of alternative reference sera in the neuraminidase-inhibition test. This report provides additional evidence that influenza viruses can cross species and cause a disease outbreak, and diagnosticians must be aware that the variability of influenza viruses can complicate the isolation and characterization of new isolates (Suarez 2002).

SECTION 11 - Most Significant Risk to Manitoba Agriculture

11.1 Risk to Small Flocks

All scientific evidence currently available supports the hypothesis the small flocks are a minor risk for remerging highly pathogenic avian influenzas. Once an Avian influenza virus becomes highly pathogenic, small flocks may play a minor role in disease transmission; however, it is significantly less in magnitude than that risk posed by commercial poultry production.

Small flock poultry production has never been demonstrated as the index flock in poultry epizootics of HPAI. It is extremely unlikely that small flocks will be implicated in any HPAI epizootic until some time after the new virus strain is identified in commercial poultry.

Manitoba does not have the live bird markets or large population of domestic ducks that has helped the H5N1 strain of avian influenza to persist in Asian.

In general Manitoba has a small poultry population in comparison to other countries with an export driven production system.

Commercial poultry production of chickens and turkeys are at higher risk than small poultry flocks of becoming infected with HPAI and being the source of transmission within their respective production systems.

11.2 Risk to Swine Production

Swine production systems have demonstrated than influenza-A can not be excluded even with the forewarning of new strains circulating in the population. It is possible that people working with pigs are acting as a biological vector for the transmission of influenza-A in swine populations.

Non-swine/human adapted strains should be easier to prevent from entering swine populations. Bird adapted strain are less likely to readily replicate and spread within the pig industry.

11.3 Risk to Poultry from Swine Production

Currently the primary risk to commercial poultry is the presence of human/swine adapted H3N2 circulating in Manitoba swine production. The virus can have significant impact on turkey breeder flocks but vaccinations are now available that appear to provide significant protection. There are no signs that the virus has spread to or caused problems in meat- or egg-type chicken flocks.

Human adapted influenza viruses currently circulating in swine are of a potential public health risk.

SECTION 12 - Most Significant Risk to Public Health

12.1 Summary

Currently the Asian strain of Avian Influenza is a minor public health risk should it emerge in domestic poultry production in Manitoba if it remains genetically stable.

While estimates are difficult to make and the risk factors associated with bird to human transmission are not completely identified the risk to human health from Asian Strain H5N1 appears to be far lower in Manitoba that other areas of the world. Compared to Asia in addition to the demographic factors, the risk to human health is further mitigated by the absence of live bird markets and the absence of migratory waterfowl in the winter months. The strong veterinary and phytosanitary controls in poultry product movement, early disease detection and outbreak control programs also work to mitigate human health risks.

12.2 Evidence

So long as the virulence of the current strain of H5N1 remains stable, Manitoba has insufficient poultry numbers and insufficient people to have a significant risk to human health from the current avian epizootic strain. Using data from Thailand as an example (Table 14), an outbreak in commercial poultry in Manitoba would provide a low probability of significant human health problems.

Table 14. Comparison of Annual risk in Manitoba using the Thai Risk Numbers

People at risk	Rate of flock infection	Number of infected flocks	Infection rate in people	Annual human cases
Thailand				
63 million	32 flocks/million people	1,600 infected flocks each year	7 human cases/ 1,000 infected flocks	11 people annually
Manitoba				
1.2 million	Assume same as Thailand epidemic	38 flocks infected annually	Assume same infection rate as in Thailand	1 human case every 250 years if poultry outbreak left uncontrolled

The high risk period for human contact with infected birds or swine will be in the agricultural surrounding prior to the identification of a HPAI.

While the odds of human infection are low, Manitobans will be concerned by the sight of sick or dead wild birds if the Asian H5N1 strain of avian influenza emerges in wild waterfowl. At least a small percentage of infected Canada Geese would be expected to display nervous signs or death. These large animals congregate in the same areas where people are found and sick or dead birds will be obvious. Urban areas such as Winnipeg are major staging grounds for Canada Geese with the city home to 150,000 Canada Geese during the fall migration. If even just 5% of Canada Geese display symptoms, significant number sick birds will be visible to the general public.

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