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ABSTRACT: A Eurasian lineage highly pathogenic avian influenza virus (HPAIV) of the clade 2.3.4.4b (Goose/Guangdong lineage) was detected in migratory bird populations in North America in December 2021, and it, along with its reassortants, have since caused wild and domestic bird outbreaks across the continent. Relative to previous outbreaks, HPAIV cases among wild birds in 2022 exhibited wider geographic extent within North America and higher levels of mortality, suggesting the potential for population-level impacts. Given the possible conservation implications of HPAIV in wild birds, natural resource managers have sought guidance on actions that may mitigate negative effects of disease among North American bird populations, including modification of existing management practices. Banding of waterfowl is a critical tool for population management for several harvested species in North America, but some banding techniques, such as bait trapping, can lead to increased congregation of waterfowl, potentially altering HPAIV transmission. We used an expert opinion exercise to assess how bait trapping of dabbling ducks in Canada may influence HPAIV transmission and wild bird health. The expert group found that it is moderately likely that bait trapping of dabbling ducks in wetlands will significantly increase the transmission of HPAIV among individual ducks, but there is a low probability that this will result in significant population-level effects on North American dabbling ducks. Considering the lack of empirical work studying how capture and handling methods may change transmission of HPAIV among waterfowl, as well as the importance of bait trapping for waterfowl management in North America, future work should focus on filling knowledge gaps pertaining to the influence of baiting on HPAIV occurrence to better inform banding procedures and management decision making.
Key words: Avian influenza, bird management, ducks, geese, waterfowl.

INTRODUCTION

Highly pathogenic avian influenza viruses (HPAIVs) of the H5N1 subtype (clade 2.3.4.4b of the goose/Guangdong (Gs/GD) lineage) have quickly spread across North America since their detection in December 2021 (Wille and Barr 2022), causing numerous mortality events in multiple species of wild birds. The H5Nx HPAIVs detected in North America in 2021–22 were genetically related to viruses originally detected in Europe and Asia (Verhagen et al.

2021) and have since been associated with extensive mortality in wild birds, including waterfowl, gulls, shorebirds, raptors, cranes, and seabirds worldwide (Food and Agriculture Organization of the United Nations 2023). The detection of a HPAIV in wild birds in December 2021 represents only the second incursion of a HPAIV affecting wild birds in the US and Canada, with a prior incursion of H5Nx (Gs/GD lineage of the clade 2.3.4.4) causing comparatively smaller-scale mortality in wild birds in 2014–16 (Krauss et al. 2016; Lee et al. 2016, 2018). Between late 2021 and spring 2022, the geographic extent of HPAIV detections in wild birds and number of cases of clinical disease in North America far exceeded the distribution and number of wild bird cases observed during the previous emergence of HPAIV in 2014–16. Indeed, as spring migration in 2022 progressed, HPAIVs were associated with mortality in numerous wild bird species in all major North American flyways (Canadian Food Inspection Agency National Emergency Operations Centre GIS Service 2022; US Geographical Survey 2022). Given the unprecedented geographic extent and level of mortality observed in wild birds in 2022, natural resource managers voiced concerns that HPAIV represented a threat to wild bird health in North America, with potential for population-level effects for some species.

In North America, population monitoring of waterfowl is the foundation for assessing sustainability and effectiveness of migratory game bird management, and banding is an essential component of monitoring programs (Bartzen and Dufour 2017; Cooch et al. 2021). Environment and Climate Change Canada (ECCC) has a responsibility, via the Migratory Birds Convention Act, 1994 (Government of Canada 1994), to ensure that migratory game bird harvests are sustainable, and that conservation and management actions are effective within Canada (Smith et al. 2022). Similarly, in the US, the US Fish and Wildlife Service has a mandate to manage migratory birds under the Migratory Bird Treaty Act of 1918. Bait trapping is commonly used for capturing dabbling ducks for banding, involves depositing bait at specific sites to facilitate capture, and is primarily used in conjunction with swim-in traps (Dufour et al. 1993; Dieter et al. 2009). From 2010 to 2019, approximately 44,000 ducks per year were banded in Canada, captured principally by bait trapping (Celis-Murillo et al. 2022; Supplementary Material Appendix A). Most banding-associated bait trapping occurs during late summer, in wetland habitats where ducks congregate, molt, and prepare for southward migration, but bait trapping also occurs on wintering sites in eastern Canada. Importantly, most of the preseason banding in North America happens in Canada because of where waterfowl populations congregate in large numbers. Effective management is critical given that the North American harvest is approximately 11,000,000 ducks of several species, making it one of the largest and most regulated harvests of wildlife (Zhao et al. 2018, 2019).

Avian influenza viruses (AIVs) are mainly spread by fecal-oral transmission, and using bait to capture dabbling ducks may increase transmission of AIV among wild birds in wetland habitats (Soos et al. 2012). Bait trapping, which congregates ducks in a given area, may facilitate fecal-oral transmission of AIVs because birds feed and defecate within the bait trap over several hours. Given the importance of bait trapping as a tool for estimating survival and harvest rates and harvest derivation, there is a need to assess the risks associated with bait trapping of dabbling ducks in light of HPAIV circulating among migratory birds in North America. Because of the limited published information on the effects of bait trapping on HPAIV transmission among waterfowl, we used an expert opinion approach to evaluate how bait trapping of dabbling ducks in Canada may influence HPAIV transmission, wild bird health, and the potential for population-level impacts on waterfowl during the ongoing HPAIV event in North America in 2022.

METHODS

Expert opinion exercise

In scenarios where empirical data are absent, expert opinion exercises provide a mechanism for the quantitative analysis of a research question, formalization of the information gathering process, and integration of critical information to inform decision making (Drescher et al. 2013). Gathering and synthesizing expert opinion can take many forms. Expert opinion Delphi approaches gather a group of recognized subject matter experts to assess and discuss the topic and objective of the review until a consensus is reached (Barrett and Heale 2020; Beiderbeck et al. 2021). A modified Delphi method can be used to elicit discussion among experts to ensure that knowledge and perspectives are shared but do not need consensus to be reached. Survey tools and other engagement and virtual facilitation tools can also help in the collection of perspectives from experts. Importantly, selection of the subject matter experts balances diversity of experience on the topics and capacity to overcome personal expert context, beliefs, and biases (Burgman 2016). Similar approaches, such as horizon scans and expert consensus techniques, are emerging as important tools to consider questions that are complex, multifaceted, and take risks and benefits into consideration (Burgman 2016; Esmail et al. 2020; Provencher et al. 2020; Noel et al. 2021; Sutherland et al. 2022). These considerations factored heavily into the design of this project.

We used an expert opinion approach combining online surveys with a workshop coordinated by two facilitators (JFP and AAEW) who did not answer any of the questions put to the experts. A core organizing group of ECCC staff (JFP, AAEW, ETR, CS, CMS, and JL) developed the research questions to be addressed and summarized the ecological context of duck banding in Canada (Fig. 1). To form the expert group, the core group reached out to colleagues with expertise in waterfowl ecology and wildlife disease. Experts were invited from federal, provincial, and interagency institutions within Canada with responsibilities for wildlife populations or wildlife diseases, and from academic institutions (Fig. 1). Colleagues from federal agencies in the US were invited given the joint responsibility of managing transboundary migratory bird populations. Invitations were sent to 15 experts, but because of time limitations (field work, vacation, workloads, etc.) we initiated the workshop when 10 experts confirmed participation, based on sample sizes from earlier publications using expert opinion in wildlife conservation contexts (MacCracken et al. 2013; Esmail et al. 2020; Sutherland et al. 2022).

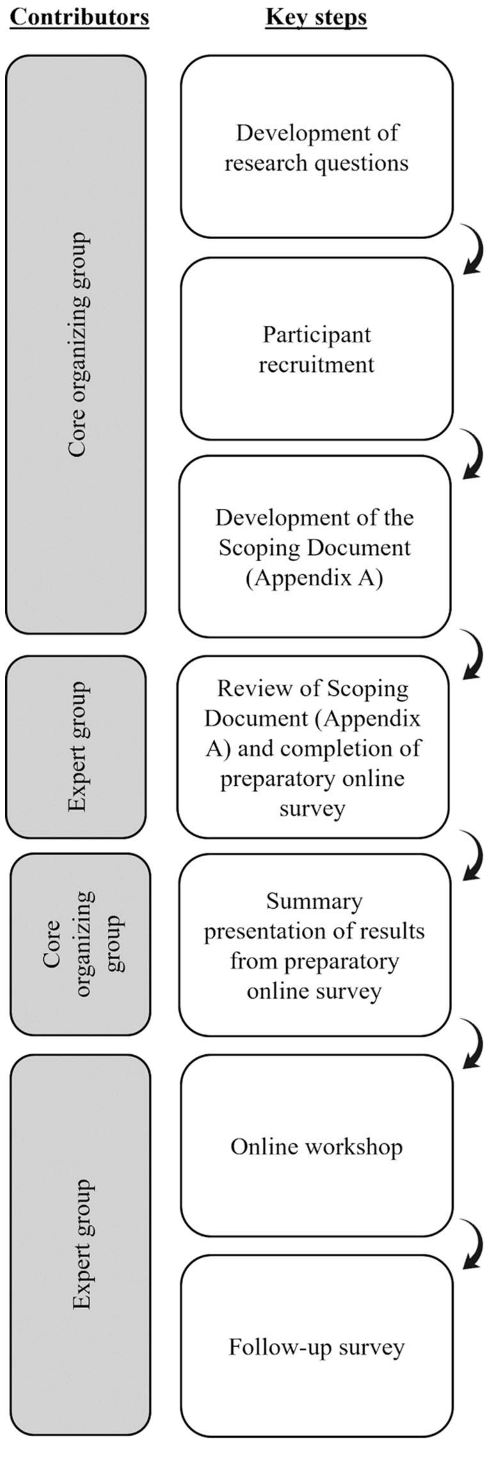

FIGURE 1. Contributors and key steps in the expert opinion exercise on how bait trapping may influence the occurrence of highly pathogenic avian influenza virus among dabbling ducks.

The core group developed a Scoping Document that was circulated to all the expert participants for review and feedback (Fig. 1). The purpose of this Scoping Document was to confirm key assumptions and definitions that would be critical to a common understanding of the current knowledge on the topic and the scale of the work to follow. A finalized Scoping Document (Supplementary Material Appendix A) was circulated to the expert group as background material along with the link to a preparatory online survey (Fig. 1; see "Online surveys and workshop" section).

Group expertise

During the initial survey, participants were asked to self-assess their expertise in six fields: 1) waterfowl ecology, 2) waterfowl management, 3) waterfowl mark-recapture techniques and analysis, 4) wildlife health (not specific to birds), 5) infectious diseases of birds, and 6) avian influenza transmission and dynamics (Supplementary Material Appendix B). We asked each participant to rank their expertise in these fields using the following categories:

No expertise—This is an area that is outside your current, or past, study area (e.g., you have not studied, have never taken any classes on this subject, or have never been a part of any peer-reviewed paper on this subject).

Some expertise—This is an area that is adjacent to the majority of your work or you have been active in the past, but it is not a primary subject area you currently work in (e.g., you led peer-reviewed papers more than 10 yr ago, you have been a secondary or tertiary contributor on a peer-reviewed paper, or you have contributed to studies in the field on this subject).

Significant expertise—This is a primary area of your current work (e.g., you have led or been senior author on a peer-reviewed paper in this subject area in the last 5 yr, or you are the current lead on a major project on this topic).

Online surveys and workshop

On 18 May 2022, a preparatory online survey was circulated among the 10 participants for completion using Google Forms (Fig. 1). We posed 16 original questions from three themes: 1) waterfowl management, 2) avian influenza dynamics in wild birds, and 3) benefits of using bait traps for banding purposes (Supplementary Material Appendix C). The online survey closed on 27 May 2022, and facilitators prepared a summary presentation of the responses to these questions, which was used to facilitate discussions during the online workshop (Fig. 1; Supplementary Material Appendix D). The presentation was shared with the expert group on 1 June 2022 to ensure that participants could review the material before the meeting and prepare questions before the online workshop.

The online workshop held on 2 June 2022 was led by a single facilitator (JFP; Fig. 1). The group discussed the original 16 questions from the survey, revised concepts, and generated agreed-upon statements relating to the three themes covered by the preparatory survey. Once each statement had been discussed and revised, the final statement was displayed on the screen and the experts were asked to enter the likelihood of the event occurring, as well as their uncertainty for the statement. The facilitator edited statements in real time to accurately represent the group's response to questions; a note taker from the core planning group recorded the statements and discussion points (AEEW). With the addition of a likelihood statement for each of the 16 questions, except for one question that asked experts to list species, there was a total of 31 questions in relation to the potential influence of bait trapping on the transmission of HPAIV among birds, with some targeted specifically on dabbling ducks.

As part of the final activity of the online workshop, the expert participants were asked to respond to six additional questions (Questions 17–22; Supplementary Material Appendix E). For these, expert participants entered their votes as each question was posted on the screen, without any discussion (hereafter referred to as the "lightning round"). Uncertainty was not assigned to the lightning round of questions as they were designed to be extensions of the previously discussed ideas and to gauge the group's thoughts across several recurring themes.

To further explore some themes after the online workshop, a follow-up survey with 11 additional questions was sent to the experts on 8 June 2022 (Fig. 1; Supplementary Material Appendix F). This included statements about AIV dynamics, as well as questions examining the relative risk of increased AIV transmission among birds in a variety of scenarios where bait is used or birds are caught for banding purposes.

We categorized consensus based on likelihood scores submitted by the experts (i.e., negligible, very low, low, moderate, or high) based on previous work in the wildlife health field (Jakob-Hoff et al. 2014; Travis and Smith 2019). In Delphi studies, consensus is often not defined; however, a large number of studies use percent agreement, most often with 75% being a median threshold to assign consensus (Diamond et al. 2014). When all experts agreed or disagreed with the statement, a score of strong agreement or strong disagreement, respectively, was attributed to the statement. As is common to Delphi approaches, if 75% to 99% of the experts agreed or disagreed with the statement, a score of agreement or disagreement, respectively, was assigned. If the group was split, and all levels of likelihood scored less than 75% of the expert votes, no consensus was attributed to the statement.

A summary of the online workshop results (final statements and results on agreement-disagreement voting) and results from the follow-up survey were circulated to the expert group on 8 June 2022. All experts were invited to review and validate the summary results based on their experience of the discussions and the raw data from the workshop and follow-up survey. Comments were received on the summary results document until 13 June 2022 and incorporated into the finalized results (for a full outline of the process see Supplementary Material Appendix G).

Risk and uncertainty

Questions framed for this exercise focused on general AIV statements and bait trapping in relation to dabbling ducks, to address immediate concerns related to management activities in 2022. The scope was relatively narrow to enable a quick assessment by the expert participants and did not include all scenarios that may increase the risk of transmission for migratory birds.

We considered risk associated with various aspects of HPAIV dynamics, including transmission and prevalence in birds. Expert participants were asked to assign a level of risk of each statement occurring. The following levels were used to describe the perceived probability of events taking place:

Negligible—The situation described is almost certain not to occur but could occur under exceptional circumstances. The likelihood is virtually zero.

Very low—The situation described is very unlikely to occur.

Low—The situation is unlikely to occur.

Moderate—The situation described is fairly likely to occur.

High—The situation described is likely to occur.

Several types of uncertainty are applicable when discussing avian influenza in wild birds. Although low pathogenic AIVs (LPAIVs) and HPAIVs have been studied for decades (Webster et al. 1992; Parmley et al. 2009; Mu et al. 2014; Gorsich et al. 2021), the H5N1 HPAIVs circulating in North America and globally in 2021–22 were considered novel and represented an emerging disease threat to wild birds (Ramey et al. 2022). Therefore, although the experts had knowledge on avian influenza, there was great uncertainty about how contemporary H5N1 HPAIVs compared to previous viruses causing outbreaks in wild and domestic birds.

Type and level of expertise may impact an individual's perception of uncertainty on specific topics (Burgman 2016). Participants included individuals with extensive expertise in disciplines relevant and specific to the survey (e.g., waterfowl biologists), as well as those from a variety of backgrounds and perspectives, including veterinarians, wildlife health experts, and those in management and policy fields. Further, to account for uncertainty that may arise due to different career stages, we ensured that expert participants included individuals with >5 yr of experience (mid and late career stages) and those early in their careers (<5 yr experience).

RESULTS AND DISCUSSION

The detections of HPAIV H5N1 in late 2021 and early 2022 in wild birds throughout North America led many wildlife agencies to consider the impacts the outbreak would have on migratory birds and populations. Consideration was given to how HPAIV may affect wild birds in the context of bird handling practices, hunter harvest, and baiting practices that congregate birds in the environment. Given the limited number of studies directly examining AIV transmission and spread in relation to bird handling and baiting, we used expert opinion to consider the available information and address immediate policy needs.

The expert group

Ten expert participants took part in the opinion exercise; however, for some questions only eight or nine answered. Of the nine experts who completed the online survey, most (78%) had significant or some expertise on waterfowl ecology (Supplementary Material Appendix B), and all had some or significant expertise in wildlife health (not necessarily specific to birds) and infectious diseases of birds. For the themes of waterfowl management, waterfowl mark-recapture techniques or analysis, and avian influenza transmission and dynamics, most expert participants (78%, 89%, and 78%, respectively) had some or significant expertise.

A number of limitations to expert opinion approaches were encountered in the development and execution of this study. First, we had a limited number of participants because several of the invited experts were unable to participate. We found that capacity was limited for wildlife health experts because of workload associated with the management of wildlife infectious diseases in North America at the time (e.g., avian influenza in migratory birds, SARS CoV-2 in mammals). We included expert participants only from North America, and primarily from Canada, and, although this was recognized during the recruitment process, we opted to proceed given the Canadian-specific context and management of baiting and banding in the country.

Online workshop and surveys: There was high degree of agreement on several themes considered in our expert opinion exercise, including HPAIV transmission routes and likelihood that migratory birds will carry the virus (Fig. 2). From the online workshop several finalized statements showed high agreement and relatively low uncertainty, suggesting that these statements were supported widely by the experts with high confidence. As a result, these statements can inform discussions around HPAIV in birds and in relation to bait trapping of ducks. The three statements that had strong agreement (100%) and a low uncertainty score from the online workshop were the following:

(1) There is a high probability (i.e., likely to occur) that some diving and dabbling ducks caught in traps in Canada will be carriers of HPAIV H5N1 in 2022.

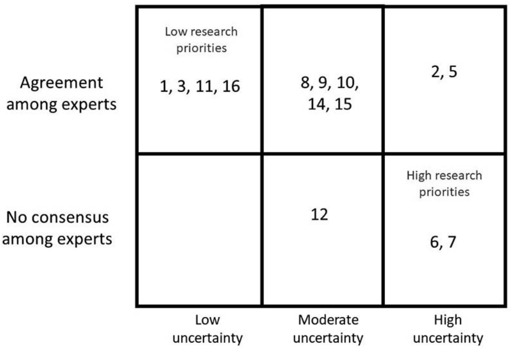

FIGURE 2. Grid showing the summary research priorities from the expert opinion exercise on how bait trapping may influence the occurrence of highly pathogenic avian influenza virus among dabbling ducks, based on the level of agreement among experts for the statements, and the level of uncertainty. Statements that have low agreement among the experts, and high uncertainty, are categorized as high research priorities. The statements where there was agreement among experts, and low uncertainty, are categorized as low research priorities. See Supplementary Materials Appendix D, Table D1 for research priority numbering. Statement 4 is not included in this grid because it was deemed not applicable.

(2) There is a high probability that a positive duck at a bait trapping site will interact with a healthy duck once released.

(3) There is a very low probability (i.e., unlikely to occur) that a practical alternative capture technique would gather enough ducks for demographic estimate purposes at similar resource levels.

Additionally, two statements showed agreement among the experts (75%), and a low uncertainty:

(1) There is a high probability that there is a viable route of transmission for HPAI between bait-trapped ducks (after release) and the population as a whole.

(2) There is a high probability of increased HPAIV transmission risk with a decrease in ambient temperature.

Agreement on these statements suggested there was sufficient information at the time of the workshop to formulate a consensus opinion. Although many statements were straightforward, they can inform questions related to currently unknown aspects of HPAIV in North America in 2022 and onwards. That is, when a new introduction of a pathogen occurs, it is paramount to assess what changes may be anticipated, as well as what is expected to remain constant. On the other hand, themes having low uncertainty included select aspects of duck ecology (e.g., contact between species), banding methods, and AIV transmission dynamics (e.g., AIV survival in relation to temperature). Interestingly, these aspects of wildlife disease ecology are outside pathogen-host dynamics and instead are variables in relation to duck populations and AIV independently.

Several statements showed agreement among the experts (75%), but with high or moderate uncertainty (Fig. 2). These included the following:

(1) There is a high probability (i.e., likely to occur) that HPAIV will affect (clinical signs) individual dabbling ducks in North America in 2022.
(2) There is at least a moderate probability (i.e., fairly likely to occur) that the current HPAIV will have more detrimental effects on dabbling duck populations than previous HPAIV.
(3) There is a high probability of increased HPAIV transmission risk as the length of time that the bait is on the landscape increases.
(4) There is a high probability that transmission rates for current HPAIV in wild birds will be higher than the transmission rates of other HPAIVs previously encountered.
(5) There is a very low probability (i.e., very unlikely to occur) that the current HPAIV transmission among birds can be mitigated at baiting sites.
(6) There is a low probability (i.e., unlikely to occur) that bait trapping in the 2022 HPAIV event will significantly bias demographic estimates (survival, harvest, etc.).

Statements with high agreement and high uncertainty included themes on the interaction between host and pathogen, and host and the environment, suggesting that although the experts may have informed opinions from past experiences with AIV, there was significant uncertainty in how current HPAIVs would interact with hosts and the environment. Given the continued evolution of HPAIVs affecting wild birds, this was not unexpected, and these topics warrant further investigation to refine future risk assessments (Ramey et al. 2022; Wille and Barr 2022).

In both the online workshop and the follow-up survey, the expert participants were asked whether the presence of a symptomatic HPAIV-infected bird should result in the cessation of banding activities; in both cases, no consensus was reached. Although this could suggest a division of expert opinion, it may also indicate uncertainty in the context and type of banding activities and the risk of potential stoppage from natural (i.e., non-AIV related) mortality events. Expert participants noted that clinical signs of HPAIV in wild birds can mimic other diseases, and, in certain circumstances, visibly sick birds presumed positive for HPAIV have then tested negative (Canadian Food Inspection Agency National Emergency Operations Centre GIS Service 2022). The discussion among the experts during the online workshop suggested that banding scenarios are site- and species-specific, and decisions on banding activities need to be context-specific and include the consideration of local knowledge.

Does bait trapping pose a risk to ducks from HPAIV in 2022?

During the follow-up online survey, expert participants were asked to address how bait trapping of dabbling ducks during the 2022 HPAIV event could increase transmission of the virus between individual ducks, and if these activities would have population-level impacts (Fig. 3, two-part question). Expert opinion was split on the first question, with half of experts indicating a moderate probability (fairly likely) that bait trapping would increase transmission of HPAIV among individuals, and the other half indicating a low or very low probability of this occurring, with moderate to high uncertainty

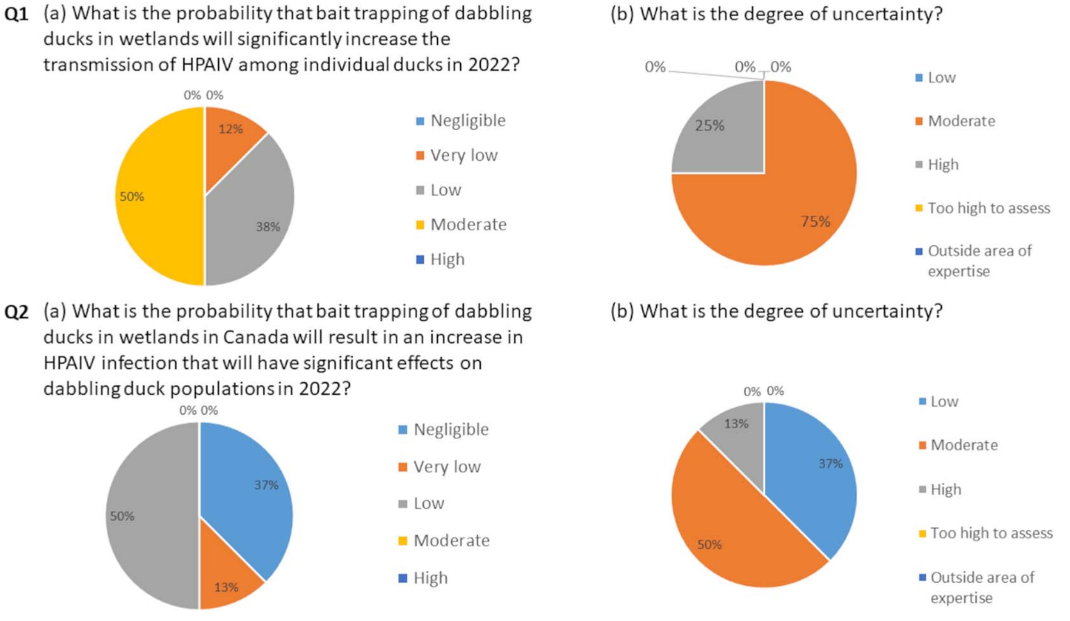

FIGURE 3. Pie charts showing the results from the follow-up online survey of the expert opinion exercise on how bait trapping may influence the occurrence of highly pathogenic avian influenza virus (HPAIV) among dabbling ducks on individual transmission and population-level effects related to bait trapping of dabbling ducks in 2022 and the HPAIV event. Q1a and b in this figure were questions 23 and 24 in the sequence of questions from the overall expert opinion exercise, and Q2a and b in this figure were questions 25 and 26 in the sequence. See Supplementary Materials Appendices C and D for the other questions.

among experts (Fig. 1, Q1). In the second question, we found that all experts indicated a negligible to low (i.e., not likely to unlikely) probability that any increase in HPAIV infection associated with bait trapping of dabbling ducks in wetlands in Canada would have significant effects on dabbling duck populations. Thus, although expert opinion was split on individual-level effects on dabbling ducks in bait traps during an HPAIV event, there was a fairly consistent opinion that population-level effects were unlikely. One reason for this seeming contradiction in conclusions is that based on experiences in other regions, HPAIV was likely to be widespread on the landscape, especially in dabbling ducks, which have relatively high prevalence of low pathogenic AIV that may induce some level of protection against severe disease. This difference in perceived risk of HPAIV transmission among individual ducks and populations may be attributed to uncertainty pertaining to the ability of the virus to persist in duck populations, and transmission dynamics in free-ranging populations, both of which warrant further investigation in general for AIV, and specifically for the 2022 outbreak.

Relative risk among different baiting scenarios

The follow-up online survey also assessed the relative risks between different baiting scenarios. The objective of these questions was to gauge the estimated risk of instances where bait may be used in slightly different ways, including different landscapes, and in the presence of traps versus no traps. By examining the expert participant responses to the scenarios posed, we found that scenarios where baiting was used but the birds were not held, and the bait was not left on the landscape, had a perceived lower risk for increased HPAIV transmission as compared to bait traps in wetlands (Supplementary Material Appendix F). Half of the expert participants (50%) suspected that where bait was left on the landscape over a period of months (e.g., depositing grain or corn in the environment to attract and hold birds in conjunction with hunting) posed a higher risk to HPAIV transmission compared to transmission from bait traps in wetlands (Supplementary Material Appendix F). Thus, these types of scenarios warrant additional reflection, and investigation is required to assess the ability of HPAIV to persist in different environmental matrices.

Environmental persistence of HPAIV: As indicated in the previous section, expert opinion on the risk associated with baiting birds was associated with landscape type, which is linked with persistence of the virus in the environment. Although there is a known link with some habitat characteristics (e.g., ground cover type, temperature) and the persistence of AIV in the environment, we found limited consensus and moderate certainty for the statement "There is a low probability (unlikely to occur) that AIV transmission (to birds within a trap) is greater when baiting on water, as compared to land bait traps."

Interestingly, we found agreement (75%) and low to moderate uncertainty for the statement in relation to transmission of AIV in relation to temperature "There is a high probability (likely to occur) of increased HPAIV transmission risk with a decrease in ambient temperature."

Although there is evidence that HPAIV can survive for relatively long periods in water and thus may serve as an environmental reservoir for infection (Himsworth et al. 2020; Ramey et al. 2020), there is still large uncertainty among experts on how this leads to changes in bird transmission of the virus. This suggests that, in general, the significance of the role of the environment as a reservoir of HPAIV remains unclear.

Future areas of research: This exercise highlighted some important knowledge gaps in relation to the specific HPAIVs circulating in North America in 2022. We found several statements during the online workshop that had low agreement among the experts and high uncertainty; these are research priorities that should be undertaken in the future. Specifically, finalized workshop statements that showed no consensus among the experts and high uncertainty should be considered for future research endeavors (Supplementary Material Appendix D). Statements with no consensus among the experts and high uncertainty included the following:

(1) There is a high probability (i.e., likely to occur) that the current HPAIV has a higher transmission among ducks as compared to previous HPAIV.
(2) There is a low probability (i.e., unlikely to occur) that AIV transmission (i.e., to birds within a trap) is greater when baiting on water, as compared to land bait traps.

This suggests that the transmission of HPAIV in 2022 is still unknown and may differ from previous AIV events that have been studied in more detail.

The incursion and spread of Gs/GD lineage H5N1 HPAIV of the clade 2.3.4.4b across North America in 2022 needs specific consideration given its potential for population-level impacts on migratory birds. Our expert opinion process was precipitated by conflicting needs to band waterfowl for ongoing management purposes versus minimizing potential negative effects to wild bird health from aggregating waterfowl (Bartzen and Dufour 2017). Key group findings have been presented to policy makers in ECCC and included that bait trapping of dabbling ducks in wetlands would probably significantly increase HPAIV transmission among individual ducks, but that this increase was unlikely to have significant effects on dabbling duck populations. While context-specific, expert participants generally considered that the use of bait can increase the risk of HPAIV to migratory birds. Future research to understand HPAIV outbreak dynamics in both waterfowl hosts and the environment may help managers to reduce uncertainty regarding risk to migratory bird population health.

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Any use of trade, firm, or product names is for descriptive purposes only and does not imply

endorsement by the US Government. This report was reviewed and approved by the US Geological Survey under the Fundamental Science Practices policy (http://www.usgs.gov/fsp/). The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the US Fish and Wildlife Service.

SUPPLEMENTARY MATERIAL

Supplementary material for this article is online at http://dx.doi.org/10.7589/JWD-D-22-00163.

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