



Research, part of a Special Feature on [Risk mapping for avian influenza: a social-ecological problem](#)  
**Avian Influenza H5N1 and the Wild Bird Trade in Hanoi, Vietnam**

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**ABSTRACT.** Wildlife trade and emerging infectious diseases pose significant threats to human and animal health and global biodiversity. Legal and illegal trade in domestic and wild birds has played a significant role in the global spread of highly pathogenic avian influenza H5N1, which has killed more than 240 people, many millions of poultry, and an unknown number of wild birds and mammals, including endangered species, since 2003. This 2007 study provides evidence for a significant decline in the scale of the wild bird trade in Hanoi since previous surveys in 2000 (39.7% decline) and 2003 (74.1% decline). We attribute this to the enforcement of Vietnam's Law 169/2005/QĐ UBND, introduced in 2005, which prohibits the movement and sale of wild and ornamental birds in cities. Nevertheless, 91.3% (21/23) of bird vendors perceived no risk of H5N1 infection from their birds, and the trade continues, albeit at reduced levels, in open market shops. These findings highlight the importance of continued law enforcement to maintain this trade reduction and the associated benefits to human and animal health and biodiversity conservation.

**Key Words:** *avian influenza H5N1; wild bird trade; Vietnam; avian conservation; legislation*

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## INTRODUCTION

Wildlife trade and emerging infectious diseases pose significant threats to human and animal health and global biodiversity and it is increasingly recognized that interdisciplinary research among conservation biologists, veterinarians, epidemiologists, social scientists, medical researchers, and practitioners is required to address these issues (Bell et al. 2004, Daszak et al. 2004, Chomel et al. 2007, Jones et al. 2008).

Obtaining precise estimates of the scale of wildlife trade is problematic because much of it is conducted illegally through underground national and international networks (Broad et al. 2003, Karesh et al. 2005, Fèvre et al. 2006). Available evidence suggests that illegal wildlife trade for food, traditional medicine, pets, and decoration ranks second to the illegal narcotic trade in terms of the financial value of illegal activities (Roth and Mertz 1997).

Many species are now threatened with local and global extinction as a consequence of the dramatic increase in hunting levels in recent decades (Milner-Gulland et al. 2002). The resulting biodiversity loss

not only has important implications for tropical forest dynamics and ecosystem services (e.g., Fa et al. 2002), but the trade systems involved also pose direct disease risks to animals and man (Bell et al. 2004, Karesh et al. 2005, Fèvre et al. 2006, Swift et al. 2007).

A recent analysis of emerging human infectious disease (EID) origins (Jones et al. 2008) found that not only were these mainly zoonoses (60%), but most of them originated in wildlife (72%) and their number was increasing significantly over time. Recent EIDs such as severe acute respiratory syndrome (SARS) and highly pathogenic avian influenza (HPAI) H5N1 demonstrate the severe impacts that such diseases may also exert on human livelihoods and global economies (Bell et al. 2004, Robertson et al. 2006, Sonaiya 2007). Both emerged in China and Southeast Asia, a region identified as a global hotspot for EIDs (Jones et al. 2008), wildlife trade (Bell et al. 2004, Karesh et al. 2005, Karesh et al. 2007, Robertson 2007) and species diversity and endemism (Brooks et al. 2002). In Vietnam alone, almost 850 species of birds have been recorded, 36 of which are listed as globally threatened (BirdLife International 2008). Live animal markets across the geographical region are

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high-risk locations for disease transmission because of the high concentration and mixing of a wide range of domestic and wild taxa originating from in-country and across-country sources and their exposure to high-density urban human populations.

From November 2003 to April 2008, HPAI H5N1 strains spread to 61 countries worldwide, killing 240 people (WHO 2008, World Animal Health Organisation 2008), many millions of poultry (World Animal Health Organisation 2008), and an unknown number of different taxa of wild birds and mammals, including endangered species (Keawcharoan et al. 2005, Robertson et al. 2006). The virus seems to have evolved in intensive poultry farming (Gauthier-Clerc et al. 2007, Capua and Alexander 2008) and appears to be highly pathogenic to a wide range of mammal and avian taxa, with mortalities in 51.8% of the 27 avian orders reported so far. The primary mode of H5N1 spread between countries has been via legally and illegally traded poultry and other avian taxa (Alexander 2000, Van Borm et al. 2005, Capua and Marangon 2006, Olsen et al. 2006, Wang et al. 2006, Gauthier-Clerc et al. 2007), although factors including the use of poultry manure as fertilizer or fish food and the movement of infected fighting cockerels and wild birds may also be implicated (Cunningham and Bell 2005, Capua and Alexander 2006, Chomel et al. 2007).

It has been estimated that approximately 4 million live birds are transported around the globe each year (Karesh et al. 2005). A large proportion of these birds originate from countries in Southeast Asia in which wild birds are widely collected for consumption as food, to keep as caged decorative or song birds, and for release to gain religious merit (Nash 1993, Karesh et al. 2007). Bird market surveys prior to 2004 suggested that ownership of caged birds increased in popularity over the previous decade in Hanoi (Morris 2001, Franklin 2005) and Ho Chi Minh City (Eames 1991, Craik 1998).

The present study set out to quantify anecdotal evidence for a major decline in the volume of domestic trade in wild birds in Vietnam since 2005. We explore the roles of HPAI H5N1 and new government legislation in this decline and the reasons why birds are sold in Hanoi markets, the identity of the species on sale, bird vendor demographics, their attitudes, and the impact of the latter decline on their livelihoods.

## METHODS

### Study sites

At the time of this study, Hanoi, the capital of Vietnam, was its second largest city, with a population of approximately 3.3 million people. It comprised seven inner and five suburban districts. The six major bird markets in the city of Hanoi are located within four of the inner districts. Each market is made up of differing numbers of individual bird shops; Dong Xuan has two; Hang Da, six; Mo, five; Lang Ha, one; Tang Bat Ho, six; and Hoang Hoa Tham, seven. These markets were selected for this study because they are the main ornamental bird markets within Hanoi and were the focus of two previous wildlife trade studies in 2000 and 2003 (Morris 2001, Franklin 2005). Such markets are also more easily monitored than the “mobile” bird vendors who sell birds from the back of bicycles/motorbikes moving around the city.

### Market surveys

Preliminary visits were made to each market to determine the location of the shops and to practice rapid identification of the bird species present. Two field guides were used (Nguyen et al. 2005 and Robson 2005) to assist with the identification of unfamiliar species. During the actual surveys, one day was spent at each of the markets (3, 6, 8, 18, 20, and 22 May 2007) identifying the numbers of all species available for sale in each shop and recording these data into a notebook or dictaphone. Any bird that could not be identified in situ was photographed for later identification. A database was compiled of 44 nonpasserine and 79 passerine species based on those species recorded during the previous two surveys in 2000 and 2003 and adding any new species as these were observed. Initial counts were calculated for individual shops, and these were combined to produce total counts for each bird market.

All three survey periods (July–August 2000 and 2003 and May 2007) were outside the peak bird migration times (April and October) during which there could be an increase in bird species observed. The exact date of each survey is also important, because the lunar calendar may also affect the numbers of birds on sale in view of the fact that the 4th and 9th days of the lunar month are considered lucky days for buying. One survey date in the 2000

surveys (30 July) and one in the 2007 surveys (20 May) fell on these dates.

### Interview data

With the help of a Vietnamese translator, semistructured interviews were conducted with bird vendors at each market. These used open-ended questions to allow for the discussion of additional topics as they arose. A bird vendor was considered to be a person currently selling or who had previously sold birds. Most interviewees were selected from the population of all the bird vendors in Hanoi using convenience sampling, based on whether or not they were willing to answer questions. However, some of the respondents, i.e., those who had previously sold birds and were now selling other products, were selected using snowball sampling and were located on the basis of information provided by other interviewees.

Standardized questions were used to determine the demographic composition of the bird vendors in Hanoi, the reasons why people purchase birds, whether the volume of trade had changed, and, if so, the suggested causes of this. To determine whether the bird trade had been affected by outbreaks of HPAI H5N1 in Vietnam, interviewees were asked whether selling birds was their primary source of income, how they supplemented any resulting change in income, and the fate of their bird stock during HPAI H5N1 outbreaks. After each interview, the responses were reviewed with the translator to clarify any ambiguous answers and ensure that no misunderstanding had occurred during translation.

Managers from three of the markets, i.e., Dong Xuan, Hang Da, and Mo, were also interviewed to determine how any government legislation introduced at the time of the HPAI H5N1 outbreaks had been enforced.

Semistructured interviews were conducted with the directors of the animal health departments of each of the districts containing bird markets. Again these were selected using convenience sampling based on those individuals willing to respond. Permission to conduct these interviews was granted by the director of the animal health department in Hanoi.

Additional open interviews were conducted with the Hanoi Forest Protection Branch (FPB) to determine the Forest Protection Department's remit in

controlling bird trade, enforcement levels, and the number of bird confiscations by the FPB for wildlife trade legislation violations.

Data on the number of human cases and deaths and on the number of animal outbreaks of HPAI H5N1 in Vietnam were collated from the World Health Organisation (WHO) and the World Organisation for Animal Health (OIE) Web sites.

### Statistical analysis

#### Market surveys

The total number of birds recorded at each market in different years was compared using a Chi-squared test. The data recorded from Lang Ha street were excluded from any comparisons with the survey in 2000 because this market was not included in that survey. Fifteen of the species from the lists of the 10 major species recorded in each survey were also compared using a Chi-squared contingency table to determine whether the totals recorded for different taxa varied significantly among the three surveys. For this analysis, certain species were grouped as genera, as in the previous surveys, to allow between-year comparisons. Thus the Japanese White-eye (*Zosterops japonicus*) and Oriental White-eye (*Z. palebrovus*) were grouped into *Zosterops* spp., and the Scaly-breasted Munia (*Lonchura punctulata*) and White-rumped Munia (*L. striata*) were grouped into *Lonchura* spp.

The species diversity and species richness from each of the surveys was compared using the Shannon-diversity index:

$$H' = -\sum_{i=1}^s (p_i) (\log p_i) \quad (1)$$

where  $H'$  is the diversity index,  $s$  is the number of species, and  $p_i$  is the proportion of individuals of the total sample belonging to the  $i$ th species (Smith and Smith 2001). The effective number of species was then calculated by taking the exponential of the Shannon-Weiner Index to give a measure of true diversity. Using this measure of true diversity, the similarity in diversity between the three years was calculated by dividing the smaller diversity by the larger to obtain the fractional decline in diversity.

### Interview data

Frequency statistics were used to analyze both the single-response questions, to which the respondents had only the option of giving a single answer, and the multiple-response questions, to which the respondents had the option of giving more than one answer. For multiple-response questions, data were analyzed using multiple-response coding in which the maximum number of responses provided by one person equates to the number of variables for that question. These variables were then grouped, and the frequency for each variable calculated to provide the percentage number of responses for each possible answer. Because each respondent could give more than one answer to these questions, the percentages produced total more than 100%.

Pearson's correlation was applied to the number of FPD confiscations from 2003 to 2007 to identify any changes in the enforcement level over time.

## RESULTS

### Bird trade in Hanoi

Of the 27 ornamental bird vendors within the six markets of Hanoi during the 2007 study period, 19 agreed to be interviewed (a 70.4% response rate). The number of respondents varied between markets: at Dong Xuan, two of two vendors were interviewed; at Hang Da, four of six; at Mo, two of five; at Lang Ha, one of one; at Tang Bat Ho, six of six; and at Hoang Hoa Tham, four of seven. From information provided by bird vendors, a further four individuals who had previously sold birds were located and interviewed. Three of the former bird vendors were located within the markets in which they had previously sold birds, namely, Tang Bat Ho, Mo, and Hoang Hoa Tham, and one of the individuals had moved from Lang Ha to a shop on Kim Ma street. Of the 23 current and previous bird vendors interviewed, the sex ratio was slightly female biased (43.5% males, 56.5% females). The age of the bird vendors ranged from 25 to 71, but the majority were aged 30 to 49. Only 13.0% (3/23) of the bird vendors had sold birds for less than five years, so 87.0% (20/23) of respondents had been selling birds since the outbreaks of avian influenza H5N1 began in 2003 and 65.2% (15/23) of these had been selling birds for more than 10 years.

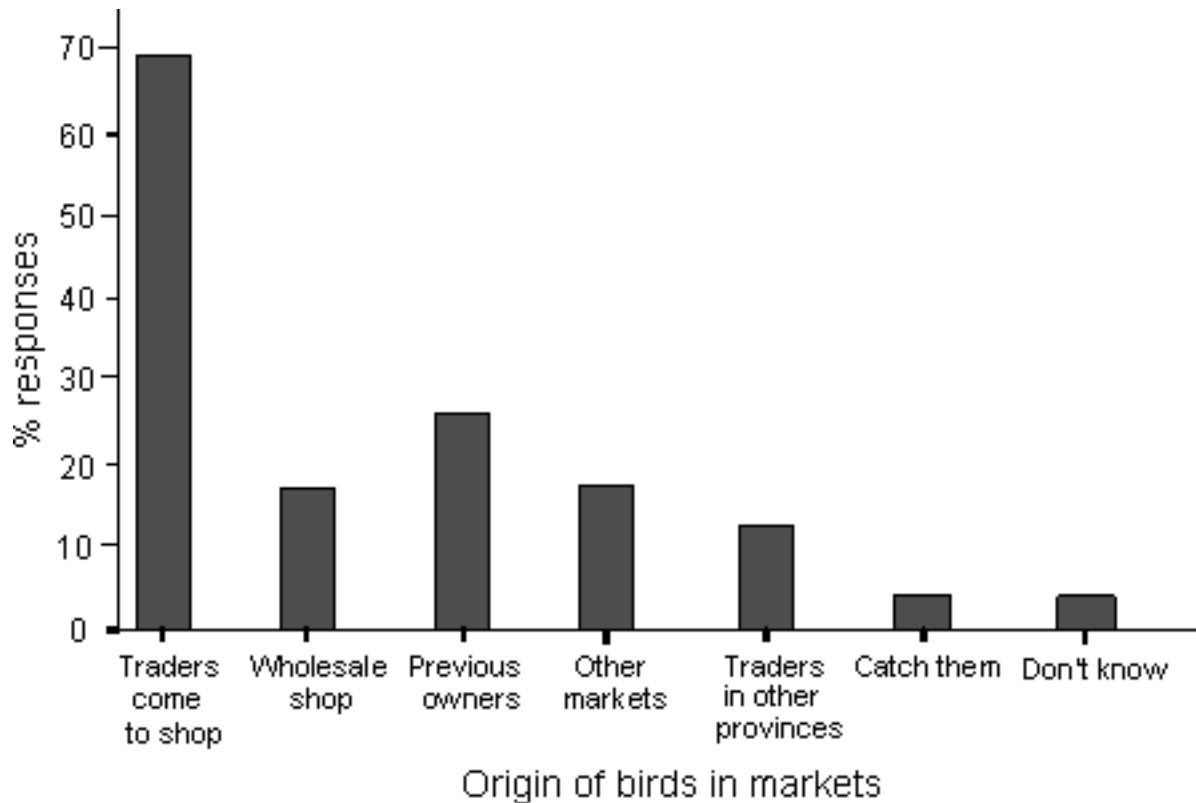
Respondents reported that the majority of the birds sold in the markets originated from within Vietnam and were wild-caught or captive-bred birds brought to the shops by traders (Fig. 1). Fourteen vendors (60.9% of respondents) claimed that they sold both wild-caught and captive-bred birds, four (17.4%) claimed that all their birds were wild caught, and five (21.7%) claimed that all their birds were captive bred. Vendors reported that species bred in captivity included budgerigars (*Melopsittacus undulatus*), canaries (*Serinus canaria*), and Java sparrows (*Padda oryzivora*). All other species recorded were reported as wild caught.

Eight of the species observed are listed under the Convention on International Trade in Endangered Species (CITES) of wild flora and fauna (UNEP 2008) Appendix II listing, which permits international trade of the species with an approved export permit. The listed species in the Convention on International Trade in Endangered Species are the Vernal Hanging Parrot (*Loriculus vernalis*), Alexandrine Parakeet (*Psittacula eupatria*), Red-Breasted Parakeet (*P. alexandri*), Grey-Headed Parakeet (*P. finschii*), Hill Mynah (*Gracula religiosa*), Red-billed Leiothrix (*Leiothrix lutea*), Silver-eared Mesia (*Leiothrix argentauris*), and the Hwamei (*Garrulax canorus*; UNEP 2008; Table 1). The first five of these plus the White-rumped shama (*Copsychus malabaricus*;  $n = 6$ ) are also listed in Group IIB of the Vietnam Government Decree 32/2006/ND-CP on the management of endangered, precious, and rare species of wild plants and animals, which restricts their exploitation and use for commercial purposes.

During the 2007 study period, a total of 1871 individuals of 41 different bird species were recorded at the six markets in Hanoi. The number of birds in each market ranged from 42 and 38, respectively, in Dong Xuan and Lang Ha to 631 in Hoang Hoa Tham street (Table 1): the latter and Mo market held most of the total stock at 33.7 and 32.3%, respectively. Of the 41 species observed, the 10 most frequently recorded species made up 80.8% of the total number of birds. Bird vendors reported that the primary reasons people purchased birds were as a pet for decoration (9/22: 40.9% of respondents) and as song birds (18/22: 81.8%), although a small amount were also bought for religious releases (2/22: 9.1%).



**Fig. 1.** Sources of market birds reported by vendors during surveys of Hanoi bird markets in 2007.



### Changes in the bird trade

The total number of birds recorded in these six Hanoi markets increased from 3041 to 7085 in the two similar surveys in 2000 and 2003 (Morris 2002, Franklin 2005; Table 2). There was a marked decline of 5252 birds (74.1%) from the total number recorded in 2003 to the number recorded in the 2007 surveys ( $n = 1833$ ). The 2007 total was also 39.7% (1208 individuals) lower than that recorded in 2000 (Table 2).

Changes in the total volume of bird trade were apparent at each market across the three different surveys (Fig. 2) as well as in the number of birds of 15 different species selected from the 10 most abundant species in each survey. There was a significant increase in the numbers of birds recorded at each market between 2000 and 2003 ( $X^2(4) = 339.11$ ,  $p < 0.001$ ) and a significant decline in the number of birds at each market between 2000 and

2007 ( $\chi^2(4) = 161.85$ ,  $p < 0.001$ ) and between 2003 and 2007 ( $X^2(5) = 352.59$ ,  $p < 0.001$ ). In every survey, the Japanese/Oriental White-eye spp. were the most commonly recorded species, with the Hwamei, Spotted Dove (*Streptopelia chinensis*), Eurasian Tree Sparrow (*Passer montanus*), and Munia spp. also appearing on the list of the 10 most numerous species from each survey. There were three species on the list from the 2007 survey that did not appear on the 2000 and 2003 lists, namely the Oriental Magpie Robin (*Copsychus saularis*), the Silver-eared Mesia, and the Java Sparrow.

The total number of different species recorded at the markets was higher in 2003 ( $n = 68$ ) than in either 2000 ( $n = 61$ ) or 2007 ( $n = 41$ ), but the effective number of species remained fairly constant across the three surveys (19.1, 14.7, and 15.9) in 2000, 2003, and 2007, respectively (Table 2). The similarity indices between the various years are as

**Table 1.** Species observed during the survey of Hanoi's bird markets in May 2007 (\* denotes threatened IUCN status). The markets are abbreviated as follows: TBH stands for Tang Bat Ho; DX, Dong Xuan; HD, Hang Da; HHT, Hoang Hoa Tham; and LH, Lang Ha.

Birds		Markets						Total	% of total
English names	Scientific names	TBH	DX	HD	Mo	HHT	LH		
Unidentified galliform	<i>Gallus spp.</i>	1				1		2	0.11
Chinese Francolin	<i>Francolinus pintadeanus</i>					2		2	0.11
Common Pheasant	<i>Phasianus colchicus</i>					2		2	0.11
Spotted Dove	<i>Streptopelia chinensis</i>	4		32	88	52	1	177	9.46
Oriental Turtle Dove	<i>S. orientalis</i>	1						1	0.05
Eurasian Collared Dove	<i>S. decaocto</i>			5	3			8	0.43
Imported Dove spp.				3			2	5	0.27
Alexandrine Parakeet*	<i>Psittacula eupatria</i>	1						1	0.05
Grey-headed Parakeet*	<i>P. finschii</i>					3		3	0.16
Red-breasted Parakeet*	<i>P. alexandri</i>					1		1	0.05
Vernal Hanging Parrot*	<i>Loriculus vernalis</i>				3			3	0.16
Budgerigar	<i>Melopsittacus undulatus</i>	22	7	18	24	41	8	120	6.41
Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>					1		1	0.05
Red-billed Blue Magpie	<i>Urocissa erythrorhyncha</i>					6		6	0.32
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	10		8	35	55	5	113	6.04
Sooty-headed Bulbul	<i>P. aurigaster</i>					3		3	0.16

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Little Pied Flycatcher	<i>Ficedula westermanni</i>			1				1	0.05
White-rumped Shama	<i>Copsychus malabaricus</i>	4		2	11	26		43	2.3
Oriental Magpie Robin	<i>C. saularis</i>	10		3	34	48		95	5.08
Pied Bushchat	<i>Saxicola caprata</i>				6	11		17	0.91
Great Tit	<i>Parus major</i>					11		11	0.59
White-crested Laughingthrush	<i>Garrulax leucolophus</i>				2	2		4	0.21
Black-throated Laughingthrush	<i>G. chinensis</i>	5	2	5	9	30	3	54	2.89
Hwamei*	<i>G. canorus</i>	9	9	7	135	119	3	282	15.07
Greater Necklaced Laughingthrush	<i>G. pectoralis</i>					1		1	0.05
Red-billed Leiothrix*	<i>Leiothrix lutea</i>	4				13		17	0.91
Silver-eared Mesia*	<i>L. argentauris</i>	18				55	2	75	4.01
Japanese/Oriental White-Eye	<i>Zosterops spp.</i>	56	7	86	137	48	6	340	18.17
Chestnut-flanked White-eye	<i>Z. erythropleurus</i>						1	1	0.05
Crested Mynah	<i>Acridotheres cristatellus</i>	1						1	0.05
White-vented Mynah	<i>A. grandis</i>				35	5		40	2.14
Common Mynah	<i>A. tristis</i>	2	3			6		11	0.59
Hill Mynah*	<i>Gracula religiosa</i>			2		1		3	0.16
Eurasian Tree Sparrow	<i>Passer montanus</i>		10	41		24		75	4.01
Java Sparrow	<i>Padda oryzivora</i>	2	4	24	55	20		105	5.61

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Canary	<i>Serinus canaria</i>	27		16	2	27		72	3.85
Scaly Breasted Munia	<i>Lonchura punctulata</i>	17		18		7		42	2.24
White-rumped Munia	<i>L. striata</i>			87				87	4.65
Gouldian Finch	<i>Erythrura gouldiae</i>			2				2	0.11
Long-tailed Finch	<i>Poephila acuticauda</i>			2				2	0.11
Paddyfield Pipit	<i>Anthus rufulus</i>				25	7	9	41	2.19
Siberian Rubythroat	<i>Luscinia calliope</i>					1		1	0.05
Total no. individuals		194	42	362	604	631	38	1871	100

follows: 2000/2003: 0.77, 2000/2007: 0.83, 2003/2007: 0.92.

All responding bird vendors (22/23, a 95.7% response rate) stated that they had perceived a decline in the bird trade in recent years, and they all attributed this to avian influenza H5N1 outbreaks in Vietnam. In addition, 68.2% (15/22) of the respondents said that the decline in trade was because of government intervention and law enforcement as a consequence of avian influenza H5N1.

Health officials in three of the four districts containing bird markets (Hai Ba Trung, Hoan Kiem, and Tay Ho) agreed to be interviewed. They explained that, since the issuing of Directive 169/2005/QD-UB, it had become illegal to transport or sell ornamental or wild birds and that this law was still in force. Fifty percent (10/20) of the bird vendors reported that they had hidden their birds from the Department of Animal Health, and 30% (6/20) said that they had released their birds directly into Hanoi.

Forty-five percent (9/20) of the bird sellers reported that they had no knowledge of the laws in place to control the trade in certain avian taxa, 10% (2/20) stated that there were no laws, and a further 10% (2/20) said that, although they were aware that there were laws in place, they did not know the details of them.

Most of the bird vendors (91.3%: 21/23) stated that they perceived no risk of HPAI H5N1 infection from handling the birds. Of the other two respondents (8.7%), one reported perceiving a small risk from handling the birds and the other claimed to have felt at risk during the first outbreaks, but when none of their birds or the other bird vendors fell ill, they stopped being concerned.

Respondents reported reacting to the bird trade decline in different ways: 52.2% (12/23) said that they had stopped selling birds during HPAI H5N1 outbreaks, whereas an additional 26.1% (6/23) stopped selling birds completely. Selling birds is the primary source of income for most of the respondents (69.6%: 16/23). During avian influenza outbreaks, 90.9% (20/22) of bird vendors sold bird food and cages to supplement their income; 68.2% (15/22) started selling other animal or plant taxa such as cats, dogs, or plants; 13.6% (3/22) sold other items such as clothing or furniture; and one (4.5%) took on additional work as a driver. All four respondents who had completely stopped selling birds were now selling different products: dogs in Hoang Hoa Tham market, bird food and cages in Mo, fish in Tang Bat Ho, and clothing in Kim Ma. The two interviewees from Tang Bat Ho and Mo stated that they would consider selling birds again when the avian influenza outbreaks ended. The other two individuals from Hoang Hoa Tham and Kim Ma said that they would not consider selling birds again because their current businesses were



**Table 2.** Comparative table of bird species recorded in Hanoi markets in surveys in 2000, 2003 and 2007. Survey 1 took place on 30 July 2000, Survey 2 ran from 26 July 2003 to 9 August 2003, and Survey 3 extended from 3 May 2007 to 22 May 2007.

Birds (English names)	Birds (Latin names)	Survey total			Total without Lang Ha	
		1	2	3	2003	2007
Galliformes						
Siamese Fireback	<i>Lophura diardi</i>	0	2	0	2	0
Grey Peacock Pheasant	<i>Polyplectron bicalcaratum</i>	0	2	0	2	0
Band-bellied Crake	<i>Porzana paykullii</i>	0	0	0	0	0
Unidentified galliform		0	6	2	6	2
Chinese Francolin	<i>Francolinus pintadeanus</i>	2	2	2	2	2
Blue-breasted Quail	<i>Coturnix chinensis</i>	11	0	0	0	0
Common Pheasant	<i>P. colchicus</i>	15	18	2	18	2
Silver Pheasant	<i>L. nycthemera</i>	0	0	0	0	0
Red Junglefowl	<i>Gallus gallus</i>	1	2	0	2	0
Green Peafowl	<i>Pavo muticus</i>	4	3	0	3	0
Helmeted Guineafowl	<i>Numida meleagris</i>	2	0	0	0	0
Columbiformes						
Spotted Dove	<i>Stigmatopelia chinensis</i>	164	257	177	235	176
Oriental Turtle-dove	<i>Streptopelia orientalis</i>	1	0	1	0	1
Eurasian Collared-dove	<i>S. decaocto</i>	2	18	8	18	8
Emerald Dove	<i>Chalcophaps indica</i>	0	0	0	0	0
Red Collared-dove	<i>S. tranquebarica</i>	0	4	0	4	0
Thick-billed Green-pigeon	<i>Treron curvirostra</i>	0	0	0	0	0

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Imported Dove sp.		0	27	5	21	5
Cuculiformes						
Greater Coucal	<i>Centropus sinensis</i>	32	1	0	1	0
Coraciiformes						
Oriental Pied-hornbill	<i>Anthracoceros albirostris</i>	2	0	0	0	0
Tickell's Brown Hornbill	<i>Anorrhinus tickelli</i>	1	0	0	0	0
Common Kingfisher	<i>Alcedo atthis</i>	4	0	0	0	0
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	3	0	0	0	0
Piciformes						
Great Barbet	<i>Megalaima virens</i>	1	0	0	0	0
Blue-throated Barbet	<i>M. asiatica</i>	1	0	0	0	0
Green-eared Barbet	<i>M. faiostricta</i>	0	0	0	0	0
Blue-eared Barbet	<i>M. australis</i>	0	2	0	2	0
Psittaciformes						
Alexandrine Parakeet	<i>Psittacula eupatria</i>	0	1	1	1	1
Grey-headed Parakeet	<i>P. finschii</i>	0	1	3	1	3
Red-breasted Parakeet	<i>P. alexandri</i>	107	29	1	20	1
Vernal Hanging-parrot	<i>Loriculus vernalis</i>	0	0	3	0	3
Budgerigar	<i>Melopsittacus undulatus</i>	54	329	120	261	112
Yellow-crested Cockatoo	<i>Cacatua sulphurea</i>	2	0	0	0	0
Lovebird sp.	<i>Agapornis sp.</i>	103	199	0	174	0
Cockatiel	<i>Nymphicus hollandicus</i>	0	32	0	30	0

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Strigiformes						
Collared Scops-owl	<i>Otus bakkamoena</i>	1	0	0	0	0
Gruiformes						
White-breasted Waterhen	<i>Amauornis phoenicurus</i>	1	0	0	0	0
Watercock	<i>Gallixrex cinerea</i>	1	16	0	16	0
Yellow-legged Buttonquail	<i>Turnix tanki</i>	0	6	0	6	0
Ciconiiformes						
Bittern		1	0	0	0	0
Falconiformes						
Unidentified raptor		1	0	0	0	0
Passeriformes						
Golden-fronted Leafbird	<i>Chloropsis aurifrons</i>	0	3	1	3	1
Blue-winged Leafbird	<i>C. cochinchinensis</i>	1	2	0	2	0
Blue Magpie	<i>Urocissa erythrorhyncha</i>	3	1	6	1	6
Green Magpie	<i>Cissa chinensis</i>	2	0	0	0	0
Large-billed Crow	<i>Corvus macrorhynchos</i>	1	0	0	0	0
Racket-tailed Treepie	<i>Crypsirina temia</i>	0	2	0	2	0
Brown Shrike	<i>Lanius cristatus</i>	1	0	0	0	0
Burmese Shrike	<i>L. collurioides</i>	0	1	0	1	0
Black Drongo	<i>Dicrurus macrocercus</i>	0	0	0	0	0
White-throated Fantail	<i>Rhipidura albicollis</i>	0	1	0	0	0
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	57	223	113	213	108
Sooty-headed Bulbul	<i>P. aurigaster</i>	5	0	3	0	3
Stripe-throated Bulbul	<i>P. finlaysoni</i>	0	0	0	0	0

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(con'd)

Light-vented Bulbul	<i>P. sinensis</i>	0	6	0	6	0
Black Bulbul	<i>Hypsipetes leucocephalus</i>	0	0	0	0	0
Minivet sp.	<i>Pericrocotus sp.</i>	0	1	0	1	0
Blue Whistling-thrush	<i>Myophonus caeruleus</i>	1	0	0	0	0
Japanese Thrush	<i>Turdus cardis</i>	1	0	0	0	0
Little Pied Flycatcher	<i>Ficedula westermanni</i>	0	1	1	1	1
Yellow-rumped Flycatcher	<i>F. zanthopygia</i>	0	0	0	0	0
Hainan Blue-flycatcher	<i>Cyornis hainanus</i>	0	0	0	0	0
Hill Blue-flycatcher	<i>C. banyumas</i>	0	0	0	0	0
Siberian Blue Robin	<i>Luscinia cyane</i>	0	1	0	1	0
White-tailed Robin	<i>Cinclidium leucurum</i>	0	1	0	1	0
White-rumped Shama	<i>Copsychus malabaricus</i>	35	55	43	51	43
Oriental Magpie-robin	<i>C. saularis</i>	75	132	95	118	95
Pied Bushchat	<i>Saxicola caprata</i>	4	2	17	2	17
Yellow-cheeked Tit	<i>Parus spilonotus</i>	0	0	0	0	0
Green-backed Tit	<i>P. monticolus</i>	0	1	0	1	0
Great Tit	<i>P. major</i>	21	9	11	8	11
Ashy Tailorbird	<i>Orthotomus ruficeps</i>	0	0	0	0	0
Prinia sp.		0	0	0	0	0
White-crested Laughingthrush	<i>Garrulax leucolophus</i>	5	1	4	1	4
Black-throated Laughingthrush	<i>G. chinensis</i>	85	76	54	56	51
Black-hooded Laughingthrush	<i>G. milleti</i>	0	91	0	82	0
Hwamei	<i>G. canorus</i>	144	324	282	311	279
Lesser Necklaced Laughingthrush	<i>G. monileger</i>	0	0	0	0	0
Greater Necklaced Laughingthrush	<i>G. pectoralis</i>	15	0	1	0	1

(con'd)

Grey Laughingthrush	<i>G. maesi</i>	0	0	0	0	0
Chestnut-crowned Laughingthrush	<i>G. erythrocephalus</i>	0	0	0	0	0
Red-tailed Laughingthrush	<i>G. milnei</i>	0	1	0	1	0
Streak-breasted Scimitar-babbler	<i>Pomatorhinus ruficollis</i>	0	0	0	0	0
Red-billed Leiothrix	<i>Leiothrix lutea</i>	118	175	17	166	17
Silver-eared Mesia	<i>L. argentauris</i>	10	28	75	23	73
Blue-winged Minla	<i>Minla cyanouroptera</i>	0	0	0	0	0
Grey-cheeked Fulvetta	<i>Alcippe morrisonia</i>	0	1	0	1	0
Japanese/Oriental White-Eye	<i>Zosterops japonicus</i>	640	2508	340	2382	334
Chestnut-flanked White-eye	<i>Z. erythropleurus</i>	3	1	1	1	0
Black-naped Oriole	<i>Oriolus chinensis</i>	0	0	0	0	0
White-shouldered Starling	<i>Sturnus sinensis</i>	63	1	0	1	0
Black-collared Starling	<i>S. nigricollis</i>	5	25	0	25	0
Black-winged Starling	<i>S. melanopterus</i>	0	33	0	32	0
Crested Myna	<i>Acridotheres cristatellus</i>	99	161	1	147	1
White-vented Myna	<i>A. grandis</i>	275	12	40	12	40
Common Myna	<i>A. tristis</i>	212	20	11	19	11
Hill Myna	<i>Gracula religiosa</i>	6	46	3	31	3
Golden-crested Myna	<i>Ampeliceps coronatus</i>	0	0	0	0	0
Brown-throated Sunbird	<i>Anthreptes malacensis</i>	1	0	0	0	0
Ruby-cheeked Sunbird	<i>A. singalensis</i>	0	0	0	0	0
Crimson Sunbird	<i>Aethopyga siparaja</i>	0	0	0	0	0
Eurasian Tree Sparrow	<i>Passer montanus</i>	114	250	75	250	75
Streaked Weaver	<i>Ploceus manyar</i>	0	0	0	0	0

(con'd)

Baya Weaver	<i>P. philippinus</i>	0	0	0	0	0
Java Sparrow	<i>Padda oryzivora</i>	19	157	105	149	105
Canary sp.		141	564	72	464	72
Greenfinch sp.		2	149	0	125	0
Vietnamese Greenfinch	<i>Carduelis monguilloti</i>	0	1	0	1	0
Yellow-breasted Greenfinch	<i>C. spinoides</i>	0	2	0	2	0
Munia sp.	<i>Lonchura sp.</i>	214	1373	129	1313	129
Red Avadavat	<i>Amandava amandava</i>	0	106	0	99	0
Green Avadavat	<i>A. formosa</i>	2	0	0	0	0
Gouldian Finch	<i>Erythrura gouldiae</i>	2	2	2	2	2
Zebra Finch	<i>Taeniopygia guttata</i>	0	27	0	25	0
Long-tailed Finch	<i>Poephila acuticauda</i>	0	0	2	0	2
Common Rosefinch	<i>Carpodacus erythrinus</i>	0	11	0	9	0
Paddyfield Pipit	<i>Anthus rufulus</i>	142	181	41	118	32
Siberian Rubythroat	<i>Luscinia calliope</i>	0	0	1	0	1
Total no. individuals		3041	7726	1871	7085	1833

doing well. The number of confiscations of birds by the FPD did not vary significantly across years from 2003 to 2007 ( $r = -0.79$ ,  $p = 0.11$ , NS).

### Outbreaks of avian influenza H5N1 in Vietnam

Following the initial outbreaks of avian influenza H5N1 in 2003, the number of human cases and deaths reported each year increased until 2006, when there was a sharp decline, and no cases were reported again until 2007 (Fig. 3; WHO 2008). So far in 2008 there have been as many HPAI H5N1 associated deaths as in the whole of 2007, with five deaths from the five reported cases (WHO 2008). At the same time, a steady decline was seen since the initial reports in 2004 in the number of reported outbreaks of HPAI H5N1 in animals until 2007, when 83 outbreaks were reported within Vietnam

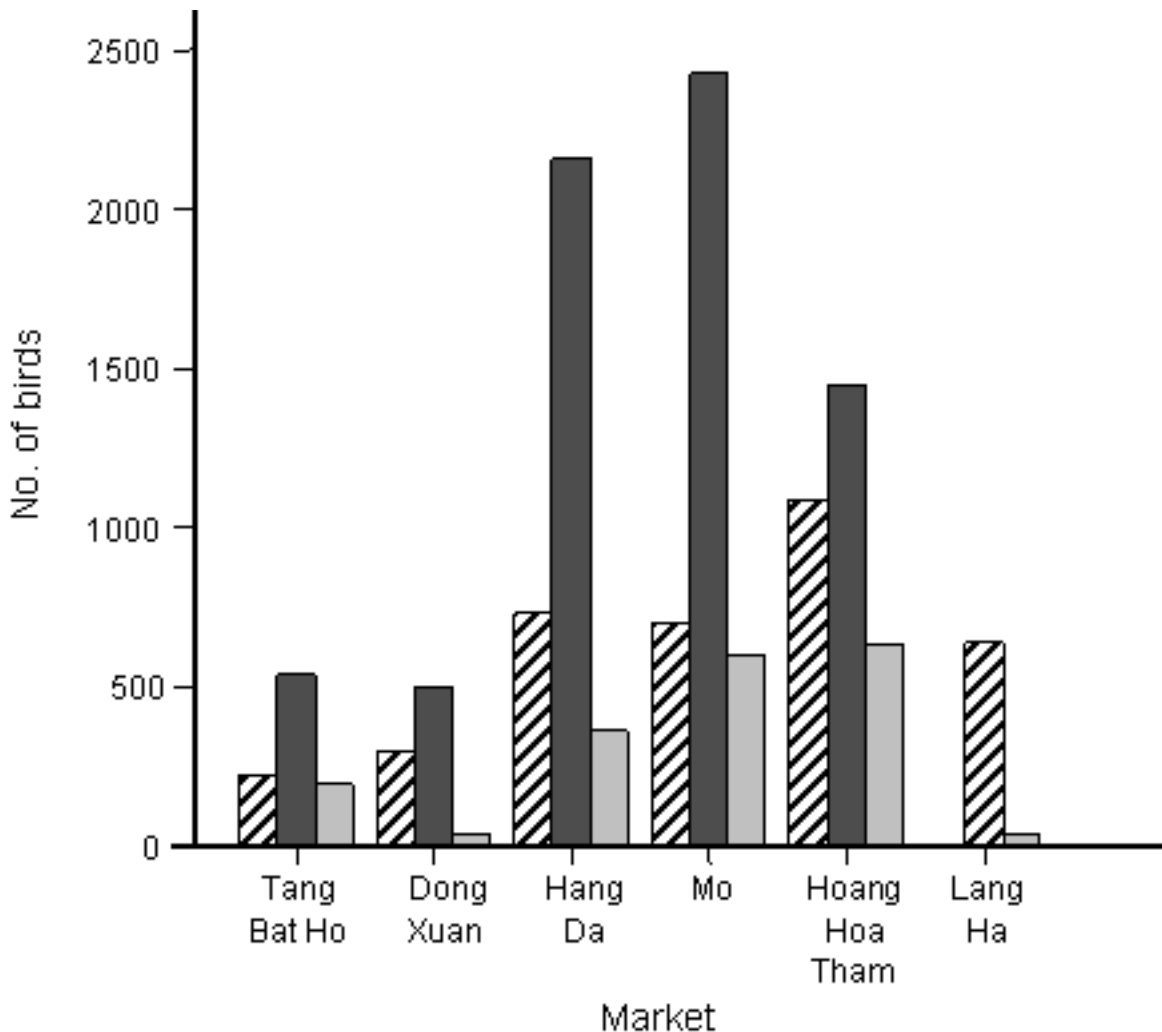
alone; 42 outbreaks have been reported so far in animals in Vietnam during 2008 (Fig. 3; World Animal Health Organisation 2008).

### DISCUSSION

Vietnam ranks second to Indonesia in terms of human cases of HPAI H5N1 with a total of 106 reported human infections and 52 deaths since 2003. However, the country reported the highest number of poultry outbreaks during this period. Poultry outbreaks and human cases peaked in 2004 and 2005, respectively, although there was an increase in both in early 2008 (WHO 2008, World Animal Health Organisation 2008). The country's success in combating outbreaks has been attributed to a



**Fig. 2.** The number of birds recorded in each Hanoi bird market during the 2000 (in stripes), 2003 (in black), and 2007 (in grey) surveys.

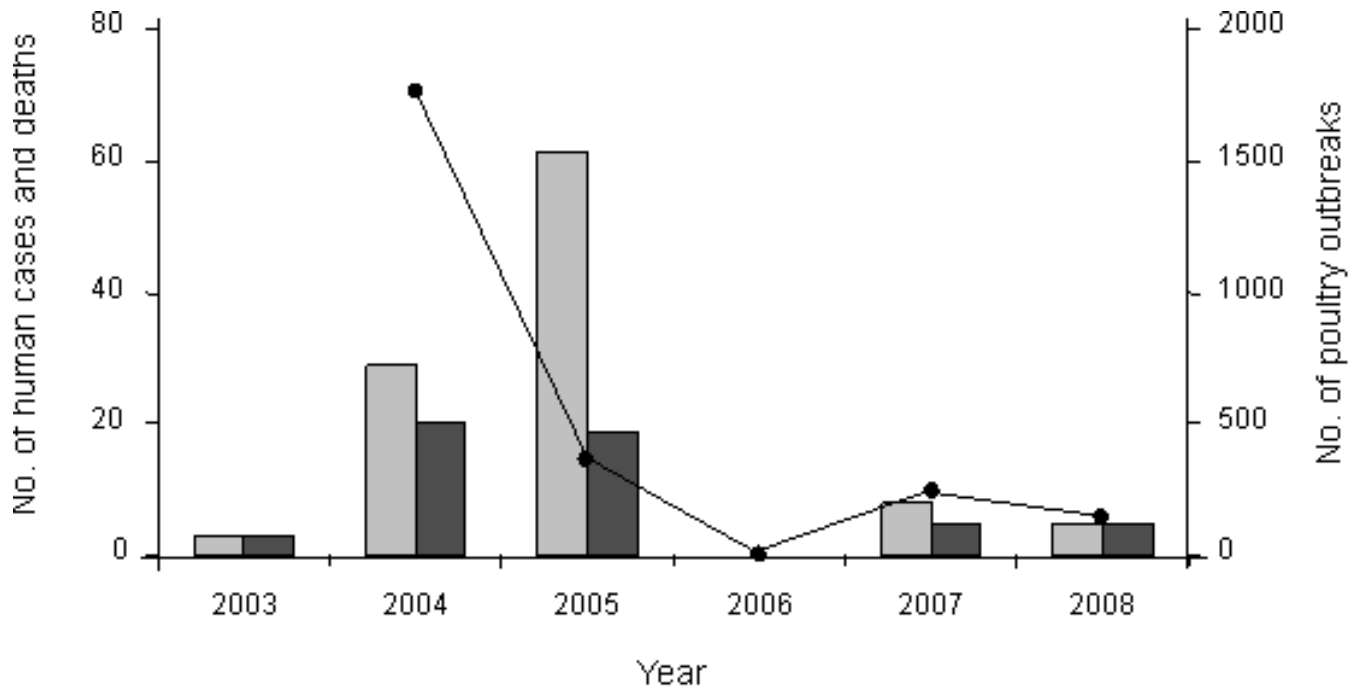


range of government actions such as the introduction of mass vaccination campaigns, among them a nationwide vaccination program completed in early 2006 that included the high-risk regions of the Red River and Mekong Deltas (Capua and Marangon 2006, Duan 2007, Gilbert et al. 2008). Since the early outbreaks within Vietnam, the level of reporting of outbreaks and people has also improved (Gilbert et al. 2008). Ornamental birds are popular in Vietnam, with households in Hanoi displaying cages containing different species of birds as decoration and for their songs. The threat posed by HPAI H5N1 in Vietnam has increased the

need for an understanding of the scale and dynamics of the ornamental bird trade, because bird markets could be possible foci for both avian influenza transmission as well as the illegal sale of threatened taxa.

Surveys of the six main bird markets in Hanoi in May 2007 found 1871 individual birds from 41 different species on sale, some of which, e.g., budgerigars, canaries and Java sparrows, were reported to be captive bred, but most of the available birds were wild caught and sold to market vendors by wholesale traders and hunters. Wild-caught taxa

**Fig. 3.** The number of reported human cases (in grey) of avian influenza H5N1 and resulting deaths (in black) in Vietnam from 2003 to 2008 (World Animal Health Organisation 2008), and the number of reported outbreaks of avian influenza H5N1 in poultry (solid line) from 2004 to 2008 (World Animal Health Organisation 2008).



included species listed in CITES Appendices, which regulate international trade, and under Vietnamese wildlife protection laws that strictly regulate their sale. The numbers of individual birds and species on sale were significantly lower than in similar market surveys conducted in 2000 and 2003, although the level of species diversity on sale remained similar across years. All the bird vendors interviewed in these markets confirmed that such a decline in trade had occurred and attributed this to outbreaks of HPAI H5N1. Sixty-eight percent of the same respondents also cited the intervention and law enforcement efforts of the Department of Animal Health to control H5N1 by prohibiting bird trade in cities as also contributing to the decline in trade. Health officials confirmed that a new law, Decree 169/2005/QD-UB, had been introduced in 2005 banning the transport or sale of ornamental or wild birds within cities as part of government efforts to control HPAI H5N1. Bird vendors reported that they perceived no personal risk from handling the birds during HPAI H5N1 outbreaks and that they had

responded to the decline in bird trade in different ways, typically by selling bird food and cages or switching to other animal or plant taxa, with a small percentage swapping to other trades. Bird vendors who had stopped selling birds in Hanoi cited the loss of income because of the decline in the trade as their reason for changing trades.

Similar surveys of the same Hanoi bird markets revealed an increase in the numbers of birds and species on sale between 2000 and 2003. This followed a similar trend of increasing bird trade in Vietnam reported in repeat surveys carried out in Ho Chi Minh City (Eames 1991, Craik 1998). These increases have been attributed to changes in the Vietnamese economy with the Gross National Income (GNI) per capita increasing from U.S. \$170 in 1993 to U.S. \$620 in 2005 (World Bank 2007), and ornamental birds are often bought as symbols of wealth and status (Morris 2001). This increased trade was occurring despite the introduction of various national and international laws and

conventions related to the conservation of animal taxa. The primary Vietnamese decree, 18/1992/ND-CP, introduced in 1992 to regulate the trade in wild animals and plants in Vietnam, has since been modified several times. For example, new species of bird were added to both Group IB, prohibiting their exploitation and use for commercial purposes, and Group IIB, restricting their exploitation and use for commercial purposes, when the law was revised in 2002 with Decree 48/2002/ND-CP, and again when Decree 32/2006/ND-CP was issued. Despite the decline in total numbers of individual birds and species evident in the 2007 survey, a number of taxa listed in both CITES Appendices and Decree 32 were observed on sale in each of the 2000, 2003, and 2007 surveys. Very few of the FPD staff responsible for enforcing this legislation have the necessary identification skills to distinguish between common and threatened taxa (Phong Tong Hop Son, *personal communication*). Interestingly, 65% of the bird sellers in this study stated that they were either unaware that such protective laws existed or did not know the details, which further suggests that public awareness and enforcement of this legislation requires review. In contrast to action in response to health legislation, the number of confiscations of taxa protected by FPD laws has remained at consistently low levels over the past five years.

The decline in trade seen in the Hanoi markets during the 2007 compared to 2000 and 2003 surveys occurred at a time of continuing increase in GNI to U.S. \$835 in 2007 (World Bank 2008). This suggests that the decline seen in the wild bird trade is not a consequence of people being unable to afford to purchase ornamental birds. Although previous studies have suggested that birds in the domestic trade were also being purchased for food (Nash 1993), none of the bird vendors in the present study cited food as a reason why people buy the birds, and, similarly, release for religious merit was mentioned by only 9.3% of the respondents. The consensus was that most people in Hanoi appear to be buying birds for decoration and their song.

To enforce the new 2005 law (169/2005/QĐ UBND) banning trade and movement of ornamental and wild birds in cities, the animal health department in each district of the city formed a group comprising one of their officials, a policeman, and one person from the People's Committee of the ward in which each market is based. All the districts reported that they would initially warn bird vendors that it was

illegal to sell birds, thus offering an opportunity to suspend this trade and also providing compensation of 5000 VND (~ U.S. \$0.35) for any bird handed over. If the vendors continued to sell birds after seven days, we were informed that the enforcement group would confiscate and destroy any birds that they found. Environmental companies were used to kill confiscated birds outside the city.

The amount of compensation offered to vendors per bird was far lower than its sale value. Fifty percent of the bird vendors reported that they had previously hidden their birds from the Department of Animal Health either in their homes or the countryside, whereas 30% said that they had simply released their birds directly into Hanoi. The former group resumed trading when the enforcement efforts died down. Vendor responses during the 2007 survey coupled with the high numbers of birds seen gave no indication that birds were still being hidden. It was also reported that the reduction in H5N1 outbreaks had resulted in health inspectors no longer visiting shops. This finding highlights the need for appropriate levels of compensation in such control programs and also suggests that enforcement should be sustained at regular intervals to have an effective long-term impact on bird trade.

It is interesting to note that, although total numbers of species on sale varied across the 2000, 2003, and 2007 bird market surveys, measures of species diversity indicated consistency in the level of species diversity. There have also been some changes in the species that appear in the 10 most numerous species lists from each survey. Whereas some species, like the Japanese/Oriental White-eye spp., have been the most numerous species in every survey, other species such as the Paddyfield Pipit (*Anthus rufulus*) and Canary spp., although still numerous in the 2007 survey, did not appear in the top 10 list. Another unusual observation was that, although Lovebird taxa (*Agapornis* spp.) were numerous in the 2000 and 2003 surveys, none were observed in the 2007 survey. These results highlight the need for future long-term, regular monitoring of the number of birds and species compositions in these bird markets, preferably in several Vietnamese cities. It is also noteworthy that bird vendors perceived little risk of contracting HPAI H5N1 from handling their birds, and it would seem appropriate to publicize the fact that this virus is pathogenic in a wide range of avian orders (Olsen et al. 2006, Robertson et al. 2006, Gauthier-Clerc et al. 2007, U.S. Geological Survey 2007).

Alternative explanations for the pattern of decline in the numbers of birds observed in these Hanoi markets include changes in consumer demand or in the supply or prices of birds. Data on the latter were not collected during previous surveys, so comparison across years is not possible. No surveys of attitudes to the bird trade have been conducted among the Hanoi public, and future research should include this to investigate the possibility of changes in consumer demand. Similar surveys among traders supplying shops are more difficult to conduct because of the illegal nature of this activity. It is interesting to note that seven vendors reported that, since the H5N1 outbreaks, the number of traders visiting their shops had declined, but they did not link this to reduced supply. Also, vendors reported that the wild-caught birds they were selling had originated from within Vietnam, with none stating that they had been sourced from neighboring countries, although this occurs with other taxa in the wildlife trade when Vietnamese populations have been significantly diminished by overexploitation. There has been no monitoring in Vietnam of wild populations of those species for sale in the ornamental bird trade (J. Pilgrim, *personal communication*), and future research should include such long-term surveying to investigate the possibility of reduced source supply of these birds. It is also important to note that the impact of HPAI H5N1 on wild bird populations has not been investigated in Southeast Asia and could provide an additional explanation for any decline in supply to traders. The additional research suggested here will help to tease apart the interaction of potential socioeconomic and biological factors influencing wildlife trade dynamics.

Regular enforcement of health and conservation-related regulations governing the sale of ornamental bird taxa are required by both the Department of Animal Health and the Forest Protection Department to control the bird trade within cities across Vietnam. Improved enforcement may lead to larger numbers of birds being confiscated, which highlights the need for a review of the fate of confiscated animals. The common practice of releasing animals at the site of confiscation should be strongly discouraged because it may contribute to the spread of any pathogens such as HPAI H5N1 that they may be carrying. Public knowledge of key information about HPAI H5N1 within Vietnam is poor, and an improved education program highlighting the risks to human health and biodiversity and the possible routes of infection

transmission may reduce the scale of the wild bird trade and other high-risk activities, including illegal movements of fighting cockerels and poultry species. The conditions found in the markets of Hanoi increase the risk of disease transmission and are typical of the live animal markets found across Southeast Asia and China, so the findings of this research in Vietnam have widespread application.

Responses to this article can be read online at:  
<http://www.ecologyandsociety.org/vol14/iss1/art28/responses/>

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