

The local bird trade and its conservation impacts in the city of Guiyang, Southwest China

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Abstract China has a history and reputation of substantial exploitation of wildlife, and the harvest and trade of wild birds are common throughout the country, both for exportation and local demand. This study documents the diversity and quantity of birds being traded in the city of Guiyang, Southwest China, and evaluates its potential conservation effects. Data were collected through direct observations and through informal conversations on weekends in a public market between March 2014 and February 2015. In total, 206 species belonging to 40 families and 13 orders were recorded, with the family Turdidae having the largest species diversity observed (28 species). The number of individuals on sale was greatly variable among different species. Ashy-throated parrotbills (*Paradoxornis alphonsianus*) were the most encountered birds, mainly driven by the practice of bird fighting, followed by *Acridotheres cristatellus*, *Garrulax canornus*, *Zosterops*

japonicas, *Zosterops palpebrosa*, *Zosterops erythropleurus*, *Rhyacornis fuliginosus*, *Emberiza elegans*, *Leiothrix lutea* and *Phoenicurus aureus*, which are all common and native to Guiyang. Our data indicated that at least 2000 individuals have been traded in one year for each of these species. We argue that the current bird trade raises a serious potential threat of over-exploitation of these species, especially due to bird fighting and hunting during the breeding season, as well as raising further potential threats of invasive species spread and disease transmission. Measures to control the trade are discussed here, and environmental education could be the most effective. This study highlights the significance of paying more attention to the domestic bird trade in the subtropical region.

Keywords Southwest China · Wild bird trade · Conservation concern · Bird fight · Environmental education

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Introduction

Human life is closely related to wildlife because wildlife is an important source of food, medicine and companionship for human populations (Collar and Gil 2007; Tidemann and Gosler 2010). This intimate relationship has driven widespread legal and illegal commerce and trade in wildlife. Wildlife trade can generate a significant cash income for the poor and provide considerable revenue at regional and country scales (Nijman 2009). For example, the illicit wildlife trade has been estimated to be the third or second largest illegal trade in the world (Barber–Meyer 2010; Sain-Len-Berry 2000). Because of the high profit and rising demand, the harvest and trade of wildlife has become a major threat to biodiversity and ecological services by

decreasing the population of the traded species and even pushing several species to the edge of extinction (IUCN 2014).

Birds are one of the groups most involved in the trade of wild animals worldwide (Chutia and Solanki 2013; Nijman 2009), as they can be utilized for numerous purposes. For example, because of their colorful plumage, attractive plumage pattern and abundant vocal repertoire, birds have been one of the most frequently kept pets. Birds are also used as food and medicine, and parts of their bodies can be exploited for adornments and decorative accessories (Alves et al. 2009; Herrera and Hennessey 2007; Ribon et al. 2003; Teixeira et al. 2014). The various forms of consumption, together with other factors, such as habitat loss and fragmentation, the introduction of exotic species, pollution and natural disasters, have significantly impacted avifaunal structures worldwide (Alves et al. 2013b, Fernandes-Ferreira et al. 2011).

China is one of the areas of highest avian diversity on earth, with more than 1300 species recorded (Mackinnon et al. 2000; Zheng 2011). China is also abundant in endemic species and harbors approximately 105 endemic species (Lei and Lu 2006), some of which are endangered and have received broad attention, such as the Japanese ibis (*Nipponia nippon*). In recent years, a growing number of new species and bird records have been reported (Chang et al. 2010; Yu et al. 2014; Zhou and Jiang 2008). However, because of illicit hunting, decline and population collapse have also been observed even for once a super-abundant bird: the yellow-breasted bunting (*Emberiza aureola*) (Kamp et al. 2015), indicating that the avifaunal richness of China requires better conservation measures.

The Chinese are known to have liked birds since ancient times, demonstrated by their important position in Chinese traditional culture. Many birds have been designated as being good luck. For instance, the red-crowned crane *Grus japonensis* represents elegance and longevity, and the mandarin duck (*Aix galericulata*) symbolizes sweet stories, whereas the calling of the common magpie (*Pica pica*) indicates the appearance of fortuitous events (Dong et al. 2007). On the other hand, some Chinese consider wild birds as a natural resource deserving to be exploited, hence the widespread use of birds for pets or food resources (Zhang et al. 2008). For instance, the practice of keeping wild birds as pets is common throughout the country. Caged birds can be found in the tree-lined streets, restaurants, stores and residential buildings of urban cities and the rural areas of small towns. "Bird walking" is common, an outdoor activity in which bird keepers walk or stroll along the street with a caged bird in the morning. On weekends or holidays, gatherings are often held in city parks, where the bird keepers may take photographs of their pet birds and share their knowledge on taxonomy and

experience on bird keeping. In the recent Hollywood blockbuster *Transformers 4*, scenes of hanging bird cages appeared several times, highlighting the well-known and cultural significance of bird keeping in China.

The laws related to wildlife protection in China consider animal resources national property and protect rare and endangered species (national key protected species), and species with important ecological, economical or scientific research values. These laws protect approximately 70% of the birds of China (945 species), of which 18% are on the list of national key protected species. The non-native birds listed on the Appendices I and II of the Convention on International Trade in Endangered Species on Wild Fauna and Flora (CITES) are classified as categories I and II of national key protected species, respectively. Hunting, selling and keeping wild birds are not allowed without government permits which can be issued only if the purposes of hunting are to carry out academic study, captive breeding, exhibition and pest control and in exceptional circumstances, such as the need for disease control. They are criminal offenses when protected species are involved regardless of whether they are wild-caught or captive-bred. Only 17 exotic and 8 native species (including 6 protected species) can be traded and kept when these birds are captive-bred individuals. None of them are national key protected species.

Nonetheless, the development of the economy in China has contributed to a substantial increase in the demand for birds (Zhang et al. 2008). The robust demand has led to a worrisome situation in which the selling of wild birds is widespread both in the large public markets of urban areas and small open fairs of towns. Although much attention has been paid to the conservation implications of the capture and trade of wild birds at the international level, data that illuminate the illegal bird trade at the local or regional level and its impact on the wild populations are scarce (Alves et al. 2009). This is particularly the case in China where the practice of capturing and trading birds is widespread, but its scale and conservation implication at the local level have received little attention. Investigations have been conducted in five cities so far (Bi and He 2005; Huo et al. 2009; Wu et al. 2005; Xu et al. 2002; Zhang et al. 2002).

Southwest China is a biodiversity hotspot as well as a region fraught with large amounts of wildlife trade. In an earlier study, numerous markets for trading wildlife were found in Guangxi and Yunnan, leading to a severe scenario where the wildlife resources have been impacted significantly (Zhang et al. 2008). Guizhou Province has a record of more than 450 bird species (Wang et al. 2011), and it is inhabited by a total population of approximately 35 million people of various cultural populations (ethno-racial groups). Wild birds are important in the daily life of the local inhabitants. Guiyang is its provincial capital city and has more than

20 cultural populations including Han, Buyi, Miao, Tujia, Shui. Many pet birds can be easily seen in the tree-lined streets, restaurants, stores, residential buildings and public parks. Keeping birds is also popular in its rural areas, particular in the Miao ethnic community (personal observation) where it is very common to encounter caged birds carried by farmers even when they are working in the fields.

In view of many pet birds in an area of such rich biodiversity and cultural diversity, this study surveys the species diversity and the number of specimens being traded in the public markets in Guiyang City and assesses its impact on wild birds. Recently, researchers have suggested that biological invasion and disease should be integrated in the risk assessment and management of live bird trade (Karesh et al. 2005; Springborn et al. 2015). This study thus discusses its potential effects both on the natural population and ecosystem. The current work specifically attempts to:

1. Catalog the species being traded in the local public markets.
2. Quantify the level at which these species are being traded, particularly for those species requiring conservation attention.
3. Identify the practices related to bird trade that may result in an over-exploitation of wild population.
4. Highlight the associated environmental concerns with live bird trade in Guiyang.
5. Discuss the measures to control the live bird trade, not just in the city of Guiyang but also elsewhere in China.

Materials and methods

Study area

This study was conducted in the city of Guiyang, located in the center of Guizhou Province. The city has an area of approximately 2577 km² (including its rural areas) and a total population of approximately 3 million. It is a mountainous region (karst landscape) with an average altitude of 1200 m above sea level, and it exhibits a subtropical humid climate with an average annual precipitation of 1129.5 mm. The habitable climatic environment has resulted in diversified avifaunal populations, in which 225 species have been observed by the bird watchers (<http://www.birdreport.cn>), representing more than half of the total bird species in Guizhou Province.

Methods

The present study was conducted between March 2014 and February 2015. Visits were made to open markets in the metropolitan area of the city. With the help of the local bird

keepers, three public markets for selling birds were found, of which the one located at the edge of the urban area of this city was the largest. This largest market was found to serve as the principal center for a wide variety of wild animal trafficking, whereas for the other two markets wild-caught birds have not been observed and only a few captive-bred species, such as *Melopsittacus undulates* and *Padda oryzivora*, were sold (Dai and Zhang 2015). These captive-bred species were abundant in all the three markets.

We therefore focused on the largest market in the following surveys. This market has at least ten stores specializing in selling birds. On weekends, people living in and around the city gather at this market, leading to the appearance of highly active bird selling by the hunters who sell the wild birds they captured and raised, the middlemen who buy the wild birds in rural areas and take the specimens to markets for reselling, and the bird keepers who want to sell or exchange their pet birds. The surveys were thus conducted each weekend except for on days of heavy rain.

Information was obtained by means of direct observations. Efforts were devoted to confirming the various characteristics of the species being commercialized, such as their species identification, origins, numbers and prices. The data were also collected through informal conversations with people involved in the bird trade, such as the bird hunters, middlemen and bird keepers. A total of 48 people, including four owners of bird stores and 40 hunters, were informally interviewed. Conversations were aimed to acquire information on the origins and prices of their selling birds. Species were identified with the help of a field guide (Mackinnon et al. 2000) and Handbook of the Birds of the World Alive (<http://www.hbw.com>).

It is very difficult to estimate an accurate number of the individuals involved due to several aspects of uncertainty in this study. First, many people crowd into the market on the weekends. The high density of people resulted in difficulty in walking and counting the birds on sale. Second, due to the policemen patrolling the market at random times, the vendors sometimes hid the wild-caught birds and were unwilling to provide information on the number. Furthermore, several vendors sold their birds by walking, further adding to the difficulty of making an accurate estimation.

Hence, a conservative estimation was applied to the species with a number of specimens. Based on a period of observation, the minimum number of individuals on sale was identified. The frequency of bird selling, as well as the proportion of bird sold each time, was also registered for the 40 hunters in the market. As the frequency has reportedly been once a week and almost all the birds can be sold out each time, the total numbers handled per year were

estimated by the minimum number multiplied by 50 weeks considering the fact that the bird trade was near halt during the Spring Festival (about two weeks). For species with a small quantity of individuals, however, the number was counted directly.

Results

Diversity of birds being traded

In total, surveys definitely recorded 206 bird species belonging to 40 families and 13 orders (Online Resource 1). Although *Gallus gallus domestica* and *Columba livia domestica* were very common in the market, these two species were not listed in the checklist because they are domesticated. Passeriformes (153 species, 74% of all species), Psittaciformes (24 species, 12%), Columbiformes (5 species, 2%) and Galliformes (5 species, 2%) were the most frequently observed orders. Cuculiformes (4 species, 2%) was an order frequently encountered during the breeding season (Table 1). The families with the largest number of species observed were Turdidae (28 species) followed by Psittacidae (18), Timaliidae (17), Emberizidae (13), Sturnidae (10), Muscicapidae (10) and Fringillidae (10) (Online Resource 2). Eleven families had only one species.

Among the species traded, 170 were native to China, of which 30 species were transported from neighboring cities or other provinces, and seven species may have been imported from other nations, usually from Southeast Asia (*Psittacula alexandri*, *Copsychus malabaricus*, *Acridotheres javanicus*, *Acridotheres tristis*, *Acridotheres albocinctus*, *Ampeliceps coronatus* and *Gracula religiosa*). The number of exotic species was 36, including 22 parrots (Cacatuidae and Psittacidae), 5 Estrildidae (waxbills) species, 5 Fringillidae (finches) species, 2 Emberizidae species, 1 Columbidae species and 1 Turdidae species. Ten exotic and 3 native species were permitted for commercial trade if these birds came from legalized vivariums (Online Resource 1), but some white-rumped munias (*Lonchura striata*) were assumed to be wild-caught birds based on morphology. Excluding the trade in allowed species, 194 species were traded illegally.

Out of the 206 species recorded, at least six were endemic species (*Bambusicola thoracicus*, *Chrysolophus pictus*, *Psittacula derbiana*, *Parus venustus*, *Garrulax poecilorhynchus*, *Latoucheornis siemsseni*). Nine species are listed as threatened or near threatened in the IUCN Red List (IUCN 2014), of which 3 are native. However, five native species are listed as threatened and nine near threatened in the Red List of China's Biodiversity (RCB). Three exotic cockatoos are in Appendix I of CITES, and 26

species including 12 native species are in Appendix II of CITES, while 30 species including 13 native species are listed in China's key protected species of Aves. Trade in all these species is illegal, due to the fact that all these species cannot be legally traded without permits, and no permits are issued for such trade. The species mentioned above are listed in Table 2.

The surveys indicated that the majority of the species on sale by the bird stores were captive-bred species, exotic species and species native to China but distributed beyond the area of Guiyang, whereas the majority of local species were sold by local hunters and middlemen.

Number

In general, among the exotic species, species allowed for trade were represented by large numbers, whereas the number of specimens for the illegally traded species was small, with few species having more than 10 individuals. For example, the diamond dove (*Geopelia cuneata*) and chestnut-backed thrush (*Zoothera doherityi*) were represented only by two specimens each. Native species from the other regions, however, always had numerous individuals despite being illegal. For example, hundreds of Hill myna (*Gracula religiosa*) could be found every visit, and although the Bearded parrotbill (*Panurus biarmicus*) was not observed every time, when encountered, the number was usually more than 100 individuals. Native species for which trading is allowed were also represented by large numbers (Online Resource 1).

The number of individuals present of species native to Guiyang was greatly variable among the different species. While most species had less than 300 individuals in total, 14 species were estimated to have more than 1000 individuals present at the market (Online Resource 1). The birds with the most-often-recorded individuals were the ashy-throated parrotbill (*Paradoxornis alphonsianus*) followed by the common myna (*Acridotheres cristatellus*), Hwamei (*Garrulax canorus*), Japanese white-eye (*Zosterops japonicas*), chestnut-flanked white-eye (*Zosterops erythropleurus*), oriental white-eye (*Zosterops palpebrosa*), plumbeous water redstart (*Rhyacornis fuliginosus*), yellow-throated bunting (*Emberiza elegans*) and red-billed leiothrix (*Leiothrix lutea*). The annual number of specimens of ashy-throated parrotbill was estimated to be more than 8000 based on up to 160 individuals observed each visit; the rest had more than at least 2000 individuals (Online Resource 1).

Native birds listed as national key protected species were represented by small numbers. However, these numbers may be underestimated because their trade is strictly forbidden. For example, raptors always appeared in the lowest numbers; five individuals of oriental scops owl

Table 1 Order level distribution of the birds observed in the market

Order	Number	Percentage (%)
Passeriformes	153	74.27
Psittaciformes	24	11.65
Columbiformes	5	2.43
Galliformes	5	2.43
Cuculiformes	4	1.94
Piciformes	4	1.94
Falconiformes	3	1.46
Strigiformes	2	0.97
Coraciiformes	2	0.97
Accipitriformes	1	0.48
Gruiformes	1	0.48
Bucerotiformes	1	0.48
Anseriformes	1	0.48

(*Otus sunia*) represented the highest number. The exotic species listed in the CITES had a few specimens, but several species had more than 20 individuals. The Alexandrine parakeet (*Psittacula eupatria*) may have more than 50 specimens, of which some were nestlings. Most of the endangered species listed in the IUCN Red List were represented by 1 or 2 specimens, but the African gray parrot (*Psittacus erithacus*) may have 10 individuals. However, more than 1000 individuals were available for the Hill myna, a vulnerable species in the RCB (Table 2).

Price

The price varied dramatically among the species and individuals within species. Generally, the illegally traded exotic species command the highest price at more than ¥3000 (US\$500, \$100 is equivalent to about ¥620). Large parrots, such as the yellow-and-blue macaw (*Ara ara-rauna*), red-and-green macaw (*Ara chloropterus*) and palm cockatoo (*Probosciger aterrimus*), sell for as high as ¥6000–120,000. Prices for the legally traded exotic species, as well as the legally traded native species, however, are always ¥50–100, but *Serinus canaria* commands a relative higher price at ¥300.

The native species from the other regions are sold for a slightly higher price, at approximately ¥300, but the Hill myna has a considerably higher price, approximately ¥1000–3000. For the species native to Guiyang, the prices are always below ¥50. Birds that are used for food are expensive, depending on the body size. Larger birds are worth more. For example, the values of ducks and pheasants are much greater than pigeons and doves. Birds that are rare and difficult to capture will command much higher prices. For example, the prices of the white-throated rock thrush (*Monticola gularis*) and raptors are always ¥300, as

a result of the former being one of the rarest birds in Guizhou Province and the latter having the difficulty in harvesting and the risk of being fined.

Within species, males are more expensive than females for species kept for their sounds due to their better singing ability. In addition, the birds kept in captivity for a long time are more valuable than recently captured ones. For instance, the sale price of Hwamei may be valued between ¥15 for a recently captured bird and ¥10,000 for an excellent singer in captivity. In particular, for the ashy-throated parrotbill (*Paradoxornis alphonsianus*), the price is determined by the fighting ability because this species is principally used for bird fighting. Individuals with a better fighting ability will be worth much more. Their values may vary from ¥2 to ¥10,000 according to their win times in the bird fights.

Discussion

Worrisome scenario of live bird trade

This year-round investigation revealed a worrisome scenario of the live bird trade in Guiyang City. Up to 194 species were traded illegally, of which more than 30 species were threatened or on the list of national key protected species although small numbers were observed in most species. Fourteen species were estimated to have more than 1000 individuals present at the market, of which 10 species had more than at least 2000 individuals. The high number of species and specimens being traded may be a big concern, especially when threatened native species were involved and some were represented by large numbers. One threatened and two near-threatened native species in the IUCN Red List were observed in trade, and according to the RCB, five and nine native species were threatened and near-threatened species, respectively. In addition, a vulnerable and a near-threatened species listed in the RCB were estimated to have more than 1000 and 3000 individuals, respectively.

The high diversity and number of individuals reflected the robust demands of local human populations and may be contributed by a number of factors, such as the important position of birds for local people, the lower prices of native species and the various types of utilization. In this view, the drivers and forms of the use of birds by the local human populations must be documented thoroughly because knowledge on the economic, cultural and social aspects of the bird trade is essential for the development of management and conservation measures (Alves et al. 2013a; Fernandes-Ferreira et al. 2011; Regueira and Bernard 2012). The end use and motivation for owning wild-caught birds will be discussed with detailed data in another paper.

Table 2 List and numbers of threatened and protected bird species encountered in the market and their respective conservation categories according to IUCN (2014), Red List of China's Biodiversity (RCB), CITES and the Chinese Ministry of the Forestry (CMF)

Species	Estimated numbers	Conservation categories			
		IUCN	RCB	CITES	CMF
<i>Chrysolophus pictus</i>	10–20	LC	NT		II
<i>Chrysolophus amherstiae</i>	10–20	LC	NT		II
<i>Aix galericulata</i>	1	LC	NT		II
<i>Centropus bengalensis</i>	1	LC	LC		II
<i>Treron sieboldii</i>	2	LC	LC		II
<i>Cacatua sulphurea</i> ^a	1	CR		I	I
<i>Cacatua galerita</i> ^a	1	LC		II	II
<i>Cacatua alba</i> ^a	2	EN		II	II
<i>Cacatua moluccensis</i> ^a	2	VU		I	I
<i>Probosciger aterrimus</i> ^a	1	LC		I	I
<i>Eos semilarvata</i> ^a	3–10	LC		II	II
<i>Eos squamata</i> ^a	3–10	LC		II	II
<i>Trichoglossus haematodus</i> ^a	20–50	LC		II	II
<i>Trichoglossus rubritorquis</i> ^a	20–50	LC		II	II
<i>Lorius lory</i> ^a	3–10	LC		II	II
<i>Psittacus erithacus</i> ^a	3–10	VU		II	II
<i>Psittacula eupatria</i> ^a	50–100	NT		II	II
<i>Psittacula alexandri</i>	10–50	NT	VU	II	II
<i>Psittacula derbiana</i>	10–50	NT	VU	II	II
<i>Ara ararauna</i> ^a	3–10	LC		II	II
<i>Ara chloropterus</i> ^a	3–10	LC		II	II
<i>Myiopsitta monachus</i> ^a	2	LC		II	II
<i>Pyrrhura molinae</i> ^a	100	LC		II	II
<i>Bolborhynchus lineola</i> ^a	200	LC		II	II
<i>Otus sunia</i>	5	LC	LC	II	II
<i>Glaucidium cuculoides</i>	4	LC	LC	II	II
<i>Accipiter nisus</i>	2	LC	LC	II	II
<i>Aviceda leuphotes</i>	1	LC	LC	II	II
<i>Falco amurensis</i>	3	LC	NT	II	II
<i>Falco tinnunculus</i>	1	LC	LC	II	II
<i>Chloropsis aurifrons</i>	3–8	LC	NT		
<i>Zoothera dohertyi</i> ^a	3	NT			
<i>Turdus dissimilis</i>	200–250	LC	NT		
<i>Gracula religiosa</i>	1000	LC	VU	II	
<i>Garrulax canorus</i>	3000	LC	NT	II	
<i>Leiothrix lutea</i>	2000	LC	LC	II	
<i>Leiothrix argenteauris</i>	40–60	LC	NT	II	
<i>Melanocorypha mongolica</i>	6–10	LC	VU		
<i>Eophona personata</i>	300	LC	NT		
<i>Emberiza aureola</i>	1	EN	EN		

Commercially bred species that can be traded are excluded

CR critically endangered, EN endangered, NT near threatened, VU vulnerable, LC low concern

^a exotic species

The current study indicated that the majority of the exotic species traded belong to the families Cacatuidae, Psittacidae, Fringillidae and Emberizidae, which is in accordance with the results from the studies on the

domestic bird trade in countries such as Brazil and Peru (Alves et al. 2013a; Fernandes-Ferreira et al. 2011; Gastanaga et al. 2010; Herrera and Hennessey 2007; Regueira and Bernard 2012). Due to their characteristics of

intelligence, beautiful plumage, docility, and a capacity to imitate the human voice, parrots are the most traded and threatened group in the world (Alves et al. 2013a; Gastanaga et al. 2010; González 2003; Herrera and Hennessey 2007). For Emberizidae species (including several species placed in Fringillidae in this study), birds were favored as a result of the several attractive attributes, such as its hardy instinct, granivorous diet, small body size and colorful plumage (Alves et al. 2009; Alves et al. 2013b). The current study reflected the worldwide popularity of these birds as pets. Given that the majority of these birds are threatened, more efforts are needed to control the international bird trade.

Among the native species, the families Turdidae, Timaliidae, Emberizidae, Sturnidae and Muscicapidae had the most species being traded. This is likely the result of the high species diversity for these families in China and either the beautiful plumage or wonderful singing of these birds. For example, the plumbeous water redstart (*Rhyacornis fuliginosus*), Hwamei, yellow-throated bunting (*Emberiza elegans*), common myna and blue-throated flycatcher (*Cyornis rubeculoides*) are the popular preferences of the local people, usually because of their beautiful bodies and wonderful vocal repertoire (personal investigation). In particular, the majority of the species in the family Sturnidae can imitate human voices as parrots do. Aside from these birds, all of the white-eyes (3 species) and doves (4 species) native to Guiyang have become commonly found in the markets, where the white-eyes are traded for pets and doves usually for food.

Perhaps a bigger concern is that the local bird trade is intense not just in the city of Guiyang but also elsewhere in China. Almost every capital city of China's provinces has at least one live bird trade market. Although data documenting the local and regional bird trade are scarce, studies have revealed that the bird diversity and number involved are worrisome. For example, Wang and Song (2000) had noted that 214 species of birds were subject to being traded in one of the bird markets in Beijing, of which 105 species were hunted from the Beijing region and 89 species were delivered from Southern China, Zhang et al. (2002) recorded 78 species at Zhengzhou, the capital city of Henan Province, Central China, Xu et al. (2002) reported 160 species traded in street markets in the urban region of Tianjin City, with 154 species being captured from the wild, Bi and He (2005) registered 64 species of wild birds being traded in the street markets in Hohhot, the capital of Inner Mongolia Autonomous Region, North China, Wu et al. (2005) observed 84 wild-captured species being traded in Xingtai, a small city in Hebei Province, and Huo et al. (2009) observed 50 species traded with 41 wild-poached species in Shenyang, the capital of Liaoning

Province, Northeast China. Species protected at the national level were encountered in all of the above studies.

More importantly, it is worth noting that the wild populations can be significantly affected because the intensive capturing and trading of wild birds have been observed during the breeding season. For example, 114 local species of birds were recorded during the breeding season in Guiyang, representing more than 50% of the birds of Guiyang (Dai and Zhang 2015). Because of the pattern in breeding activities, such as territory occupation, nest building, incubation and rearing, the breeding nests are easily found, resulting in the large number of species and individuals being harvested. The breeding harvest greatly impacts the wild populations because the birds captured may be the parent birds, which may lead to the death of their offspring. Another reason is that in addition to adults, numerous nestlings, fledglings and juveniles have been observed in the market. For example, more than 100 individuals of nestlings, fledglings or juveniles of the plumbeous water redstart were observed each weekend during the breeding season.

Bird fighting and its conservation implication

In Guiyang, the species with the largest number of individuals being captured and traded was the ashy-throated parrotbill, previously treated as a subspecies of the vinous-throated parrotbill (*Paradoxornis webbianus*). The family Paradoxornithidae thus had the most numbers being traded. Local people use it for bird fighting. Bird fights have also been reported in other countries, such as Brazil (Alves et al. 2009; Fernandes-Ferreira et al. 2011). It is similar to the cockfights, in which two birds are put into a large cage or the birds placed in two different cages and the cages are put together. Due to their aggressive nature, these birds will fight immediately. Bird keepers and the audiences place a bet on the bird they believe will win the fight. The bet can be as high as ¥3000 (\$500). The fight ends when one bird tries to escape from the cage or directly gives up without any resistance.

The match has negative effects on the bird species involved, leading to the high mortality of the fighting birds as a result of wounds and lack of care, particularly when the fighting occurs in one cage. This fact may explain the hundreds of thousands of ashy-throated parrotbill being sold in the market. Although the ashy-throated parrotbill was one of the most common and abundant local species, we are concerned about the potential effect this could have declined the wild populations sharply because of this unsustainable practice. For example, in comparison with previous years, capturing these birds has reportedly become more difficult in the wild according to the poachers.

The robust evidence for the negative effect of bird fighting came from the current population status of Hwamei, one of the most frequently caged birds in China. This bird is often used as a fighting bird in Southwest China, where many cities even hold a large-scale bird fighting match annually. The robust demand for pets and bird fights has caused wild populations of Hwamei to hardly be encountered in and around the city of Guiyang, where it is no longer observed in the wild, not even the typical breeding song often heard while bird watching.

Bird fighting has not only led to a reduction in population size of the targeted bird but also affected species that are closely associated with it. For example, the number of brood parasite cuckoos observed in the market was mostly the “by-product” of the harvest of the ashy-throated parrotbill, which has great importance as the breeding host for cuckoos. Therefore, populations of cuckoos can be impacted inextricably. In addition, researchers have argued that the removal of a large number of individuals from the natural ecosystem may have cascading effects on several ecological services (Alves et al. 2013b; Fernandes-Ferreira et al. 2011).

Invasive species

Biological invasion is one of the main global concerns and principal threats to global biodiversity (Clavero and García-Berthou 2005; Kolar and Lodge 2001). Birds comprise one of the most common invasive groups in the world, and the bird trade is one of the drivers (Cassey et al. 2004; Leven and Corlett 2004), as the wild-caught birds survived in the trade are the potentially successful invaders (Carrete and Tella 2008).

In China, the practice of keeping and trading birds has led to the establishment of wild populations of exotic species in Hong Kong (Mackinnon et al. 2000; Leven and Corlett 2004). Recently, several studies have reported a number of bird invasions related to the bird trade, such as the black-collared starling (Jian 2010; Luo et al. 2006) and the red-whiskered bulbul (Zhao et al. 2013). Perhaps the most robust evidence was from the common myna, a famous invasive species listed on the top-100 invaders (Lowe et al. 2000). A recent report has indicated that these birds have invaded the city of Harbin, Northeast China, as a result of the release of the birds bought from the bird trade market (Liu and Zhao 2013).

Concerning the bird trade in Guiyang, a number of non-native species are represented by a large number of individuals, for example the black-collared starling and common myna. These wild-caught birds highlight the concern of potential bird invasion, which could have significant impacts on native communities and ecosystem functioning

(García-Moreno et al. 2007; Huxel 1999; Zavaleta et al. 2001).

The source or sink of diseases

The bird market and its contact network may act as both the source and sink of various viruses and diseases (Karesh et al. 2005). For example, the live bird trade has been identified as the major pathway for the transmission of the highly pathogenic avian influenza virus subtype H5N1 (Fournie et al. 2013; Karesh et al. 2007). In Guiyang City, the high diversity of the bird species traded may be a large sink for highly pathogenic diseases. Furthermore, the bird market has hundreds of thousands of domesticated birds (*Gallus gallus domestica* and *Columba livia domestica*) on sale, and these birds were reared in the market throughout their lives. These birds may become viral reservoirs during the outbreak of diseases. To worsen matters, elderly citizens in the city like to buy wild birds and release them. The close contact between domesticated and wild-caught birds makes the release of market-bought birds a very dangerous action.

Conservation response

In view of the large scale of the illegal capture and sale of wild birds and its potential impacts, as well as the associated concerns, there is an urgent need to implement measures to control these activities. Although a complete ban on the wild bird trade has been suggested, conservation biologists argue that indiscriminate bans on the bird trade are unlikely to be effective (Cooney and Jepson 2005). Regulatory actions must consider the cultural, economic and social aspects of the human populations involved, which should include methods of law enforcement, market-led approaches, sustainable use approaches, environmental education and substitution-based income sources for bird poaching (Alves et al. 2013a; Alves et al. 2009; Alves et al. 2013b; Fernandes-Ferreira et al. 2011; Rabinovich 2005; Regueira and Bernard 2012).

While numerous studies have concluded that laws for regulating the wildlife trade have been insufficient in Asia (Nijman 2009), both at the international and domestic levels, China does have strict laws to punish the illegal harvest and sale of wild birds. The law of the People's Republic of China on the protection of wildlife has completely banned the hunting and killing of a species on the national official list of protected and endangered species, while the harvesting of the other protected species requires a permit from the government. According to these laws, the hunting and trading of wild birds is illegal, and may be a criminal offense that can result in a punishment of a fine

and a prison sentence of more than 10 years at most. It can be punished with a fine below ¥1000 even when the illegal harvesting has failed to collect the wild birds.

Nonetheless, the capture and sale of wild birds and other animals are widespread in China. It has been found that a small amount of enforcement would have a dramatic effect if it were enforced at the right time (González 2003). In view of the importance of the breeding period, enforcement and patrolling must be rigorously undertaken during the breeding season. Further endeavors must also be devoted to controlling the practice of bird fights.

Captive-bred alternatives have been suggested as an effective and popular solution to the live bird trade, given that plumage and singing rather than origin are the principal factors considered by the local people (Cooney and Jepson 2005; Jepson and Ladle 2005; Jepson and Ladle 2009). However, the high prices of the captive-bred birds indicate that efforts to reduce the costs of legal captive-bred birds are needed. Policies or projects that promote the keeping of captive-bred rather than wild-caught birds are also necessary.

It is worth emphasizing that the majority of hunters and keepers lack important knowledge on biodiversity conservation. They cannot identify birds belonging to the national key protected species or understand the reason for bird protection. Few hunters or keepers realize that the catch and sale of birds can be a threat to the natural bird populations. The only thing that concerns them may be the birds' economic values for the hunters and the quality of singing or the beauty of the body or coloration for the consumers. In view of this situation, bird watching may be an effective solution (Fernandes-Ferreira et al. 2011). Bird keepers could be encouraged to watch wild birds, and hunters could act as birding guides to obtain an income considering their familiarity with the distribution of local birds (Fernandes-Ferreira et al. 2011). However, sufficient efforts should be put forward to the potential effects on birds and their habitats caused by avitourism, such as overuse (Steven et al. 2011; Steven et al. 2015).

Environmental education could be the most effective action to control the serious situation (Alves et al. 2013a; Alves et al. 2009). Local human populations must be educated on the important values and various ecological functions of wild birds and the terrible consequences of the unsustainable bird trade. It has been suggested that a nationwide culture supporting environmental protection is likely to change people's attitudes toward and awareness about the catch and sale of wild birds (Alves et al. 2013a; Alves et al. 2009). This could be achieved through broadcasting more proenvironmental public service announcements in prime time and displaying environmental protection banners in local communities where bird hunting and keeping activities are prevalent. It is also

valuable to carry out intense educational efforts in primary and secondary schools.

Conclusion

The situation of capturing wild birds and the bird trade is far from optimistic in Guiyang, Southwest China, and the hunting and trade of wild birds may even be a national problem in China. The high species diversity and number of individuals being traded are a threat to the natural bird populations of several species, especially as a result of using the birds for bird fighting and capturing wild birds during the breeding season. We argue that species with large numbers being traded need attention to monitor their wild populations, especially for the ashy-throated parrotbill and Hwamei. The invasion of exotic species and disease infection have emerged as associated environmental concerns, particularly with the release of market-bought, wild birds. Confronted with such a serious situation, more endeavors must be undertaken through a combination of law enforcement, substitution-based activities, environmental education and market-led approaches. By virtue of the unexpected results from the current study, we argue that more attention should be paid to the bird trade at the local or regional level in the subtropical region.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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