Chapter 2
Biodiversity Conservation and Its Research Process

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Abstract In this chapter, we mainly introduce the wildlife vertebrates and birds conservation and research. China has great habitat and biological diversity; however, many of wildlife are in peril due to habitat loss and over exploitation in the past few decades. Ever since, China had strengthened the protection of wild animals, especially the establishment of nature reserves. Here we take the protection of giant panda, Milu and Przewalski's wild horse as case studies. For birds, China has extremely rich bird resources, highly endemism, but faces high threaten for endangered species. In addition, the development of molecular biology, bioacoustics, a variety of analytical software, various analytical models, etc, have played an important role in promoting the scientific researches and conservation of birds in China.

Keywords Biodiversity · Vertebrates · Giant panda · Przewalski's wild horse · Birds · Endangered bird species · Wild bird diseases · Conservation

1 Wildlife Conservation and Research

1.1 Introduction

China's fauna is divided by the Palaearctic and Indomalayan Realms with a boundary lies approximately along the Mt. Qinglin and Huihe River. The climate in

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China is diverse. Much of southern and southeastern China has a subtropical climate; which turns into more continental northwards and westwards. Monsoon rains affect the east coast, while the desert interior of the west has very low rainfall. The size of the country, its climate and topographical variety and its biogeographic position result in great habitat and biological diversity. Owing to the temperature difference, from the north to the south, there are Taiga, deciduous broadleaved forest, ever-green broad levered forest and rain forest in the Monsoon Zone. Wild animals in the zone are primarily forest inhabitants, like red and white giant flying squirrel *Petaurista alborufus*, sika deer *Cervus nippon*, and tiger *Panthera tigris*. Tibetan plateau characterized by the dry and cold alpine climate. Many wild animals live on the open plateau are endemic ungulates like Chiru *Pantholops hodgsonii*, Kiang *Equus kiang*, wild yak *Bos mutus*, white lipped deer *Przewalskium albirostris*, and Tibetan gazelle *Procapra picticaudata*, which are significantly different from the surrounding region. However, the differentiation of the fauna in the region is basically at the species or genus level, not the family level. Even though, Chen et al. (1996) claim the Tibetan region should be classified as a separate zoogeographic realm. Many researchers are exploring the ecological and evolutionary mechanism which determines the animal species richness pattern in China (Li et al. 2013; Luo et al. 2012).

1.2 Status of Terrestrial Vertebrates

As new species being discovered, new taxonomy is being adopted and new records are being added, and number of species in the country is increasing. Roughly, there are 2637 terrestrial vertebrate species in the country (Table 1). Endemic species varied from nearly 70 % in the amphibians to about 6 % in birds. During the last century, because of rapid economic growth, pressure on wildlife mounted in the country.

Generally, the species richness decreases from southeast to northwest in China. For an example, only 12.9 % of the 100 × 100 km grids contained more than 500 vertebrate species. These high vertebrate species richness (VSR) grids were mainly located in the southwestern areas, tropics, and sub-tropics of the country, which contained several hot spots, including the Hengduan Mountains, the Xishuangbanna region of Yunnan Province, the southeastern and southern coasts, Hainan Island, and Taiwan Island. The grids containing 200–500 species were mainly concentrated in

Table 1 No. of species and endemics of mammals, birds, reptiles, and amphibians

	No. of species	Endemics	Endemics (%)
Amphibians	298	208	69.80
Reptiles	402	131	32.59
Birds	1330	82	6.17
Mammals	607	114	18.78
Total	2637	535	20.29

the vast eastern and northeastern plains of the country, which accounted for 49.2 % of the total of grid cells. The remaining grid cells (37.9 % of the total) had VSRs of <200 and they were mainly located in the northwestern areas and Qinghai–Tibetan Plateau (Luo et al. 2012).

Many of China's wildlife are in peril due to habitat loss and over exploitation. In 1989, The *Wild Animals Protection Law of PRC* was promulgated, which was a milestone for wildlife conservation in China. One hundred and one animal species are listed in the Category I of the National Key Protected Wild Animals. 84 species are listed in CITES Appendix I, including one amphibian, six reptiles, 34 birds and 43 mammals. One hundred and forty-eight species are listed in CITES Appendix II, including one amphibian, five reptiles, 99 birds and 43 mammals. Fifty-three species (10 amphibians, 15 reptiles, 4 birds and 24 mammals) are listed as CR in the IUCN Red List; 154 species (19 amphibians, 22 reptiles, 22 birds and 91 mammals) as En; 324 species (78 amphibians, 67 reptiles, 73 birds and 106 mammals) as VU (IUCN 2013).

Habitat management is one of the most important aspects of wildlife conservation, while establishing nature reserves is one of the most important measures to protecting habitat. Nature reserve in the country is following the MAB model, a nature reserve is divided into three function zones: core zone, buffering zone, and the experimental zone. Human activities are forbidden in the corn zone of reserves. Until the end of 2012, 2669 nature reserves of 1.50 million km^2 have been established, which accounted for 15 % of the territory of China.

1.3 Case Studies

1.3.1 Giant Panda

Giant panda *Ailuropoda melanoleuca* is a relic species which lives in fragmented habitats of Mt. Minshan, Mt. Chionglai, Mt. Major Xianglin, Mt. Minor Xianglin, Mt. Liangshan and Mt. Qinglin in central China. 1,569 pandas were estimated and lived in field at the end of twentieth century according to the Third Nationwide Giant Panda Survey. Long-term isolation caused genetic differentiation in panda population. It is reported that the giant panda of Mt. Qinglin is a subspecies of giant panda due to geographic isolation. Logging was a threat to the giant panda; five nature reserves were established in 1963 to protect the habitats of giant panda. Since 1970, the country has already finished three nationwide giant panda surveys; the fourth one is nearly finished. Since 1980, many researches on the field ecology of giant panda had been conducted (Schaller et al. 1985; Pan et al. 2001). Recently, development in molecular biology, like whole-genome sequencing of giant pandas provides insights into demographic history and local adaptation of the relic species (Li et al. 2010a; Zhao et al. 2013), means to assess implications for conservation of the drastic reduction of the smallest and most isolated giant panda population.

Nationwide survey, field and molecular ecological research identified key populations and habitats of giant panda and helped to understand behavior, ecology. and evolution of the giant panda; thus, set up scientific basis for field conservation. About 60 % of giant panda habitat, supporting over 70 % of the wild populations, is now protected in 64 nature reserves, most of them are national nature reserves. The ex situ population is demographically and genetically strong, and increased efforts are underway to develop an effective release program to reinforce wild populations. On the other hand, artificial breeding of giant panda has been carried out in the Wolong, Chengdu, Beijing and Fuzhou (Peng et al. 2001, 2009). Integrated global ex situ conservation strategy is supported by the Chinese Association of Zoological Gardens (CAZG) , the State Forestry Administration (SFA), and Conservation Breeding Specialists Group (CBSG) of IUCN. More than 300 giant panda have been bred in breeding centers and zoos in China. Global ex situ giant panda population is now 375 pandas, conservation breeding plan uses less genetically valuable females designated to produce offspring suitable for release training efforts. Recently a re-wild of giant panda project is well on the operation at Wolong Giant Panda Conservation Center.

1.3.2 Milu

After the last glacial period, Milu *Elaphurus davidianus* was restricted to swamp and wetland in the region south of 43°N and east of 110°E in China. Population of Milu declined because of human hunting and land reclamation as human population expanded in Holocene. Finally, Milu was extinct in the field (Cao 1992). The first conservation reintroduction of Milu into China included two groups of 20 (5♂: 15♀) and 18 (all♀) in 1985 and 1987, respectively. Beijing Milu Park (39°07′N, 116°03′E) was established. The second reintroduction of 39 Milu, selected from five UK zoos, was carried out in August of 1986. Dafeng Milu Natural Reserve (33°05′N, 120°49′E) was established to host the reintroduced Milu (Jiang et al. 2000). Further population growth in Beijing Milu Park was restricted by its limited size. Thus, more than 300 Milu were relocated to over 50 sites all over China. Ninety-one Milu were relocated to Shishou Milu Reserve, which was established in 1993 and 1995. A flooding of the Yangtze River in 1998 resulted in several cohorts of Milu leaving the initial release area and forming permanent herds in other parts of the province, as well as around Dongting Lake in Hunan province (Maddison et al. 2012). Researchers and graduate students conducted research projects including population monitoring on the introduced Milu in the country. Three international workshops on management and research on the reintroduced Milu were held at Beijing Milu Park in 2006 and Dafeng reserve in 2011 and 2012, respectively. Recently, a team is monitoring the field-released Milu in coast marsh of Dafeng with satellite collars. Many papers have been published in peer-reviewed journals (Zeng et al. 2013; Li et al. 2011a, b).

1.3.3 Przewalski's Wild Horse

Przewalski's wild horse *Equus przewalskii* is a fleet ship species in the Jungar Basin in northern Xinjiang where the first type specimen of the wild horse was collected in the 19th century. The wild horse was reintroduced to China in 1985. From 1985 to 2005, a total of 24 Przewalski's horses (14 males and 10 females) were transported to Jimsar Wild Horse Breeding Center in Xinjiang. The first foal was born at the breeding center in 1988. Since then, a total of 258 foals have been born, and the number of animals in the captive population continues to increase. On August 28, 2001, 27 wild horses were released into the Mt. Kalamaili Ungulate Nature Reserve. Studies on the acclimation, food habit, and community-based conservation were conducted (Chen et al. 2008). Because the first released site was close to a major highway, fatal vehicle collision caused several casualties in the released wild horses; the wild horses were then relocated to Qiaobaixili region of the reserve. After acclimating to the local habitat, the released wild horse families established territories and started to breed. Seventy-two foals were born, 7 families with 73 wild horses roamed in field in 2010. Number of re-wild wild horses reached 96 by the end of 2012 (Fig. 1).

1.3.4 Wildlife Trade

Commercial trade is identified as a threat to biodiversity. Unregulated international trade in wildlife not only devastates local ecosystems, but also poses threat to the

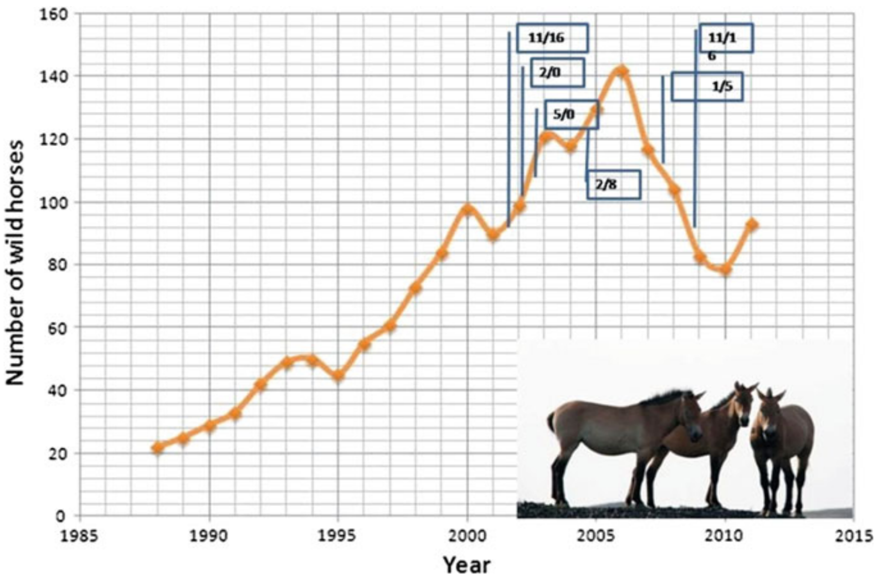

Fig. 1 Population trends of the reintroduced wild horse in Xinjiang. Numbers in the flags indicate the numbers of wild horse (♂/♀) released into field

survival of individual species. Trade records show that since 1990, with respect to some species of snakes, China has changed from a net export country to a net import country. Importing snakes sharply increased in China before 2002 (Zhou and Jiang 2004). Since then, measures of suspending snake trade had been imposed by National Wildlife Management Authority in China. Jiang et al. (2013) found both import and export of all snakes in China recorded in the CITES Trade Database and the Wild Animal and Plant International Trade Database of China have sharply decreased since 2004. Li and Jiang (2014) also found that international trade of live birds in China peaked during the late 1990s; then decreased to the level before the surge of trade in a few years. The trade dynamics of wild birds may have been affected by governmental policy and the outbreak of avian influenza during the period.

1.4 Conclusion and Discussion

Wildlife conservation is a branch of conservation science. It is to be noted that there are more conservation practices than theoretic research have been done in the field (Jiang et al. 2014, in press). The wildlife ecology should be the focus of the wildlife research in China; however, not until three decades ago, people had started to study live animals in the field. While the achievement in artificial propagation of endangered species and nature reserve construction in the country is encouraging, researches on the behavior, ecology, and management of the endangered wild animals in China have just been carried on. The reality is that many of China's wild animals either live in remote habitat, possess of cryptic nature or are of very low density; it is confronted with logistic problems to carry out field study, even though Chinese researchers are still working hard in field. Routine surveys monitor the population trends of wildlife. Progresses have been made in behavioral ecology. Radio and GPS collars and camera traps have been put in use in the field. GIS, in aid with GPS, is now widely in use for analyzing spatial data like GPS position data of animal movement and home range. Molecular ecology is developing rapidly in the country. With little samples, using PCR and computer software, people can infer the historical population trend, genetic landscape, gene flow, and population genetic structure of wild animals in laboratory, which becomes an indispensable tool in wildlife research. Nevertheless, as a country with mega animal diversity, field ecology study is not matched up with the number of species and degree of species in peril. Conservation of biodiversity, of which conservation of wildlife is a key part, is on the top agenda of the nation. There are gaps in scientific knowledge. Since many species are endemic which only live in the unique ecosystem in the country, the wildlife ecologists in the country need to desperately work more on the wild animals in the field in order to fill up the knowledge gaps. Younger field ecologists should be trained for qualifying the enormous work.

2 Biodiversity and Conservation of Birds in China

2.1 Introduction

As one of the "megadiversity" countries of the world, China has very rich bird resources; however, it has also been seriously threatened now. Increasing emergence of zoonotic diseases makes it even worse. China spans two ecozones, the Palearctic realm and the Oriental realm, which makes it an important region for biodiversity research and conservation. Benefited from new technologies in taxonomy, many new species and new records have been reported in China. The advance of phylogeography also increases our knowledge in understanding the formation of high endemism and species richness in China. This chapter therefore summarizes a brief review on the following five topics: biodiversity and distribution, endemism and conservation priority, phylogeography and molecular ecology, conservation and management for rare and endangered species, and avian diseases and eco-health.

2.2 Biodiversity and Distribution

New species or records of birds are discovered in China frequently because of the fast development of the research methodology and increasing numbers of ornithological researchers and bird watchers. During the past 50 years (1958–2008), six new species were reported by Yang and Lei (2009), e.g., *Bradypterus alishannensis*, *Phylloscopus emeiensis*, *Phylloscopus Hainanus*, *Seicercus omeiensis*, *Seicercus soror,* and *Certhia tianquanensis*. Currently, 1371 species are recognized by Zheng (2011), accounting for 13.12 % of the world total species.

China is characterized for holding both high species diversity and endemism of birds, thus has important role in conservation of world bird resources (Lei et al. 2003a, b). Some groups, such as cranes, pheasants, and babblers, have been attracting worldwide attention. Nine of 15 crane species of the world are distributed in China, while the black-necked crane is the only one in high altitude of Qinghai–Tibetan Plateau (QTP). There are 27 species of pheasants and 131 species of babblers in China, occupying more than half of the world species respectively. In China provinces, Yunnan has the highest species richness. Over 848 species account for over 62 % of the whole species recorded in China (Yang 2004), followed by Sichuan (683 species, Xu et al. 2008). Geographically, Hengduan Mountain areas harbor the highest richness, which has also been suggested as original center for many taxa. Nearly half of pheasant species and babblers are distributed here with high subspecies and population differentiation. Qinling Mountains lies in central China. It is an important boundary between the Palearctic Realm and the Oriental Realm.

China also has varied habitats, especially wetlands, and thus it has rich waterfowls. On the East Asian-Australian Flyway and Central Asian-Indian Flyway, there are the most important wintering and breeding grounds as well as stopovers for wild bird migration, for example *Grus leucogeranus*, *Grus monacha,* and *Grus grus* wintering in Poyang lake; *Anser indicus* and *Tadorna ferruginea* breeding in Qinghai lake. Climate warming was recently reported influencing the geographical distribution range of birds. One hundred and twenty species in China were reported to extend their distribution range northward, e.g., *Egret tagarzetta*, *Ardeola bacchus*, *Pycnonotus sinensis* (Du et al. 2009). Wang et al. (2010) analyzed the change of species richness patterns from 1976 to 2005 based on breeding birds distribution database and found that the richness increased in all zoogeographic subregions. Southern Yunnan Hilly subregion, Qiangtang Plateau subregion, and East Meadow subregion had the most obviously increasing but Hainan and Taiwan subregions are relatively more stable.

2.3 China Avian Endemism and Biodiversity Conservation Priority

Endemism is the most interesting question in biogeography and biodiversity conservation (Crisp et al. 2001). China is one of the most important countries in global biodiversity and biogeography. The distribution of endemic species has been considered very important for China avifaunal regionalization (Cheng et al. 1997). It has also been suggested in setting priorities for biodiversity conservation (Lei et al. 2003a, b).

The peak of richness distribution of endemic species was found in three areas, including Hengduanshan Mountains, mountain areas of western Qinling, north Sichuan province and South Gansu province, as well as Taiwan Island (Lei et al. 2003a). For endemic genera, the northern and eastern Hengduanshan Mountains, and the Qinling, Dabashan and Minshan Mountain regions have been found with the highest richness. Obviously, both endemic species and endemic genera have high richness in east edge of QTP, which was considered because of the uplift of QTP. Of these areas, Taiwan Island has the highest narrow distributed species than mainland, which implies that island isolation has great contribution to differentiation for Chinese avifauna. By comparing subregional distribution of overall endemic species, narrow distributed range species (EOSR), monotypic species and subspecific diversification, Lei et al. (2007) concluded that this pattern might reflect the avifaunal evolutionary and ecological isolation results from the highly diversified habitats and geographical environments as well as the historical effects from the primitive avifauna, inferring this “ecological island effect” hypothesis for explaining what driving this pattern. Huang et al. (2010a, b) using Parsimony analysis of endemicity recognized four Areas of Endemism (AOE): Qinghai-Zangnan Subregion, the Southwest Mountainous Subregion, the Hainan

Subregion, and the Taiwan Subregion). All these four AOEs located at the mountainous habitats, which implied the hypothesis that "mountainous environment may act as "historical and ecological barriers" preventing population gene flow, promoting speciation and maintaining a high endemism in explaining China avian endemism."

Based on endemicity of birds, biodiversity conservation hot spots and priority have been proposed. BirdLife International has ever suggested the Endemic Bird Area (EBA) in explaining avian endemism (Stattersfield et al. 1998). Lei and Lu (2006) also argued that it is wise, reasonable and practical to determine the priority for biodiversity conservation for China, a developing country. Lei et al. (2003a, b, 2007) proposed the distribution center of endemic species as the "biodiversity hotspots" in reference to set the priority of biodiversity conservation. By considering the distribution patterns of both endemic species and endemic genera, the southeastern peripheral areas of the QTP (e.g., Qinling-south Gansu mountainous region, Henduanshan Mountain areas), being considered as refugia in Pleistocene because of the high endemism and genetic diversity, should have the highest priority for conservation (Lei et al. 2003a, b; Lei and Lu 2006).

The study on distribution patterns by using GIS in China avian endemism was referenced by other taxa researches, and these algorithms for site prioritization have also been cited to identify indicative sets of potential conservation areas (Solymos and Feher 2005). The studies from the distribution pattern of endemic species and genera have inferred the "historical and ecological barrier" hypothesis, the "ecological island effect" hypothesis, and "evolutionary powerhouse" in particularly explaining the hot spot in Hengduan Mountain areas. These macro-ecology based findings have provided scientific questions and testable hypotheses for explaining the underlying mechanisms of formation of China avifauna and biogeographical distribution patterns, meanwhile the regional endemism properties have also provided new scientific questions for interpreting the global scenario of all animal endemicity.

2.4 Phylogeography and Molecular Ecology

Phylogeography is in understanding the principles and processes of forming the geographic distributions of genealogical lineages (Avise et al. 1987). Phylogeographical studies on birds obtained significant improvement by understanding the genetic consequences of the geological events on birds' population structure. Particularly, in North America, the recent population expansion was revealed in many passerine species, indicating that the current distribution patterns may be the consequences of the post-glacial population expansion during the late Pleistocene (Spellman et al. 2007). In Europe, many species experienced population expansions after the Last Glacial Maximum (LGM), which was believed profoundly affecting population dynamics (Hewitt 2000). The glacial cycles in Asia differ from those in Europe, even though the two continents spread similar latitudinal belts (Hewitt 2000). Post-glacial population expansion was less diagnosed in Asian birds, and the populations were rather stable through the late Pleistocene, inducing unique phylogeographic patterns in Asian birds. The phylogeographical researches about birds in China disclosed multiple phylogeographical patterns and glacial refuges and indicated that population divergences were much affected by Pleistocene climate changes earlier than LGM (Yang et al. 2009).

Phylogeographic patterns and its driving factors of birds in China have been well studied during the last 10 years. Phylogeographical studies on birds in Qinghai–Tibetan Plateau (QTP) revealed population dynamics and geographical distribution shifts response to Pleistocene glacial oscillations. The uplift of QTP greatly impacted the phylogeographic structure of the Plateau species, while most of the QTP species underwent population expansion after glacial movements. The eastern margin of the QTP area was detected as refugia for many plateau species during the Pleistocene glaciations. e.g., Onychostruthus taczanowskii, Pyrgilauda ruficollis, and Pseudopodoces humilis experienced rapid population expansion (0.07–0.19 Ma) from the eastern "refugia" to the platform of the plateau after the retreat of the extensive glaciers (Qu et al. 2005; Yang et al. 2006). But most species have not shown any deep phylogeographical structures, with the "no divergence" pattern, while Pseudopodoces humilis has distinct phylogeographical structure with a "north-south divergence" pattern. A "platform and edge" phylogeographical divergence was also detected by other plateau species, e.g., Carduelis flavirostris. (Qu et al. 2010). The QTP platform populations were derived from a single refuge at the eastern edge of the plateau. No bottleneck effect or population expansion was found at the lower altitude edge populations (Qu et al. 2010). The results implicates that plateau birds experienced population expansions from edge to the platform of the plateau around 0.17–0.50 mya, after the glacial extension in QTP. Elliot's laughing thrush is endemic to the Hengduan Mountain. It was isolated in different areas during the interglacial periods but connected again when they expanded to suitable habitats at low elevation during glacial periods; these repeated population isolation and extension are occurring in the spatial "sky island" pattern (Qu et al. 2011). The pre-LGM population expansions are rather earlier than post-LGM expansion scenarios common in European and North American birds. The studies shed lights on evolutionary history and formation of the avian fauna of the QTP. The refuges revealed by the phylogeographical studies are coincident with endemic hot spots detected by biogeographical analyzes, implying fundamental processes and mechanisms of avian fauna dynamics response to climate changes.

Phylogeographical structures and population divergence of south China species is different from the QTP species in many cases. Bambusicola thoracica, Alcippe morrisonia, Stachyridopsis ruficeps, and Parus monticolus distributed in Southern China are all detected with multiple phylogeographical breaks, but different species have different lineage structures. This population divergence was considered to be related to the uplift of the QTP, topographic complexity, and mountain system. Populations of most species have experienced the expansion events much earlier than the Last Glacial Maximum (LGM). The consistent patterns of this "pre-LGM" population expansion imply less impact of climate changes on birds in South China (Dai et al. 2011; Song et al. 2009; Huang et al. 2010a, b).

Remarkable achievements have been done for avian phylogeography in China within the last 10 years. The preliminary findings shed lights on the mechanism and processes of avian speciation and diversification of birds in China. The results from phylogeographcial studies also help us, from the evolutionary viewpoint, to explore the history and underlying mechanism in forming the diversity pattern as well as endemic pattern of birds in China, which enhance our knowledge in understanding the formation and evolution of the global biodiversity and endemicity.

2.5 Conservation and Management of Rare and Endangered Species

China has very rich rare and endangered bird species. From IUCN report in 2011, 124 species are threatened, 7 of them are critical endangered, e.g., *Eurynorhynchus pygmeus, Garrulax courtoisi, Pseudibis davisoni, Grus leucogeranus, Fregata andrewsi, Sarcogyps calvus,* and *Sterna bernsteini*, while 17 species are endangered, e.g., *Gyps bengalensis, Nipponia nippon, Arborophila rufipectus, Aythya baeri, Ciconia boyciana, Grus japonensis, Mergus squamatus, Platalea minor*, etc. (http://www.iucnredlist.org). In regard to conservation, China has contributed great efforts and obtained important achievements for these species. Here we have only taken fewer examples, e.g., Cabot's Tragopan (*Tragopan caboti*), Crested Ibis (*Nipponia nippon*), Black-faced Spoonbill (*Platalea minor*), etc.

Cabot's Tragopan is an endangered and endemic pheasant in China and listed as national key protected animal species (class I) by law. Since 1980, Chinese researchers have been working on the study and conservation and have now successfully solved the breeding, feeding, and conservation problems. A series of key techniques referring to the artificial sperm collection and insemination has been grasped. Based on these basic research results, Chinese scientists have now successfully established the artificial breeding population for over 100 individuals (Zhang 2005). The restoration of the habitat is the key to protect these endangered species. Since 1990, lots of habitat restoration programs have been conducted in Wuyanling Nature Reserve. The results of basic researches have been used for managing conservation strategy for the field population. The research team lead by professor Zheng Guangmei have obtained many national prizes in honor of their great contributions for the endangered species research and conservation. Crested Ibis was historically widely distributed in East Asia in China, Russia, Japan, and Korea Peninsula (Bird Life International 2001). Since 1950, the population has decreased dramatically and locally extinct in Russian, Japan and Korea Peninsula due to the shortage of foods, illegal hunting, loss of breeding trees and wetland habitats. This species was once declared to be extinct (Yu et al. 2006). In May 1981, researchers from Institute of Zoology, Chinese Academy of Sciences found a small population of only 7 birds in Yang County, Shaanxi Province. After 30 years of research and conservation efforts, the population has now increased to 1100. 600 of them are wild population distributed in 11 counties of Shaanxi province. The rest artificial populations are distributed mainly in Yangxian, Zhouzhi, and Ningshan counties of Shaanxi, in Beijing Zoo, Henan and Zhejiang provinces (Ding 2004). Because of their great achievements in research, rescuing, restoration, and management for the species, the Chinese team has received the national second prize. IUCN specialists suggested this as a successful example to the world for conservation of endangered species. The black-faced spoonbills had ever been very common in Asia in 1950s, but, the population decreased to only 288 in 1988. However, no one knows where the breeding population is. Researchers first discovered the small breeding colony in Xingren Islet, Changhai County, Liaoning Province in June 15th, 1999 (Yin et al. 1999). More breeding birds were reported and found after that, and the wild breeding area has been protected as a nature reserve.

Chinese colleagues have also actually achieved great success in protecting these rare and endangered birds but are still far from the final objectives. Here, we cannot list all these achievements from different researchers and for different species. However, conservation of birds in China also faces severe challenge as the global climate change and increasing disturbance from human activities, and especially when compared with the developed countries. The conservation program is a long-term task and thus needs a long-term effort.

2.6 *Wild Bird Diseases and Eco-health*

Birds are important hosts and vectors for many zoonotic diseases. Some of the diseases are fatal, e.g., High Pathogenic Avian Influenza (HPAI). As the most focused infectious zoonose, HPAI has tremendously threatened the economic development and eco-health of our society. Wild birds are considered natural reservoir of all known avian influenza (AI) virus subtypes, and Anatidae species are identified as the major vectors. However, whether wild birds are the hosts or vectors of H5N1 virus has been widely debated (Altizer et al. 2011; Normile 2005). H5N1 virus have ever been isolated from the Peregrine Falcon (*Falco peregrinus*), Grey Heron (*Ardea cinerea*), and other wild birds, however, these are sporadic cases, isolated viruses from migratory birds in Qinghai Lake was the first case report from wild bird population over the world (Liu et al. 2005). This finding supposed the relationship between migratory birds and global circulation of H5N1 virus. The latter on AI surveillance in wild birds in China isolated 17 strains in corresponding to five clades in the genomic phylogenetic tree, which suggested that high genetic diversity existed among H5N1 viruses (Kou et al. 2009). After the extensive surveillance programs, HPAI H5N1 viruses were isolated from diversified wild bird species, which strongly support the association between viral transmission and bird movements (Kou et al. 2005, 2009). The satellite-tracking studies on bird migration further indicated the preservation possibility of H5N1virus in the Qinghai lake areas, and spread through wild bird migration (Cui et al. 2011a, b; Li et al. 2010b, c). Moreover, resident birds could also be a potential vector to carry and spread H5N1 virus (Kou et al. 2005). However, some new genotypic H5N1 strains emerged in Qinghai Lake after 2009, which was suspected to be related with bird migration and the viruses reassortment from migratory birds and poultries (Li et al. 2011a, b; Hu et al. 2011). The breakouts of H5N1 have threatened eco-health and human society. The global epidemic of H5N1 virus has killed lots of wild bird species and caused thousands of migratory birds death, including very endangered species, e.g., Black-necked crane (*Grus nigricollis*) (Chen et al. 2006). We have also estimated the risk of H5N1 virus introduction to Qinghai Lake by using a quality–quantity integrative method and indicated that ducks and geese were most likely the vectors to introduce HPAI H5N1 into the lake through migration. The studies highlighted the importance of eco-health and AI surveillance activities around the lake, which could be guided to AI monitoring program in the whole Central Asian Flyway (Cui et al. 2011b). The finding of H5N1 outbreak in wild bird population in Qinghaihai Lake was published in Science in 2005. The paper was elected to get the “Thomson Reuters Research Fronts Awards” by Thomson Reuters in 2008, to recognize the outstanding contributions to the frontier scientific field worldwide. The significance of above researches on AI has also lies in confirming the role of wild birds in dissemination of AIV, so as to guide national AI prevention and control management, and global response to AI outbreaks; to supply crucial scientific recommendations on the establishments of the national monitoring system of AI and other emerging infectious zoonotic diseases.

2.7 Conclusion and Discussion

China has extremely rich bird resources, high endemism, but faces high threaten by endangered species. The uplift of the QTP, the Himalayan orogeny, geographical isolation of islands, and Pleistocene glaciations have greatly impacted on the endemism, distribution, and phylogeographical divergence, in facilitating the forming process of regional endemism and speciation. One hundred and tenty-four species are highly threatened, of them 7 are critical endangered; in addition, currently varied zoonotic avian diseases have also threatened the biodiversity and ecological security.

The technological developments have brought innovative opportunities for scientific researches. The development of molecular biology, bioacoustics, a variety of analytical software, various analytical models, and so on, all these have played an important role in promoting the scientific researches and conservations of birds in China and even the whole world. On morphology basis, to us multiple gene markers including mitochondrial and nuclear genes, sonograph analysis have played great role in bird taxonomy and species recognition. In particular, entering the next generation of genomics, a large number of sequences into mechanization at large scale, will dramatically reduce the financial and human resources invested, which make it possible to base on the whole genome, multiple gene combination in studying evolution, genetic diversity, phylogeny, and phylogeography researches. Despite birds are well studied among all animal taxa, there are still lack of basic knowledge in making conservation and management measures for endangered species. So, researches of behavior, ecology, geographical distribution, and biodiversity conservation are still a long way to go; therefore, basic biology in filling necessary data gap is still important. As global climate changes, illegal wildlife trade, the burst of human movements, will promote and rise the emerging of potential zoonotic diseases, so important pathogen surveillance and studies on co-evolution between pathogen and host of birds are still hot topics for human society.

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