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Wildlife conservation and management in China: achievements, challenges and perspectives

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Dramatic global changes to the environment have wrought unprecedented reductions in biodiversity, with more than 26% (31,030) of the 116,177 species assessed by IUCN as threatened with extinction [1]. China, as one of the world's megadiverse countries, plays a critical role in global biodiversity conservation. The upcoming 15th Conference of Parties (COP15) for Convention on Biological Diversity (CBD) serves as a propitious opportunity for China to make ambitious but pragmatic commitments to elevate its wildlife conservation and management activities. The development of “Ecological Civilization”, which endorses the ancient Taoist idea of Unity of Nature and Man (UNM) to achieve the harmony between human beings and nature, has greatly facilitated the mainstreaming of biodiversity conservation in China [2]. Experiences from China will shed light on wildlife conservation worldwide.

STATUS AND ACHIEVEMENTS

Species recovery and habitat protection

Chinese wildlife is protected and managed by different levels of administrations according to their classification and grading. Class I species under state protection are governed by national administration, while class II species under state protection and species under local protection are managed by local administration. Beginning with the establishment of the first nature reserve in 1956, China took significant measures to protect its wildlife, including the promulgation and revision of laws and regulations, establishment of a legal framework with specific species listed due to endangerment or ecological, scientific or social value, signing international conventions and multilateral agreements, and implementing national bans, projects and surveys (Fig. 1). Flagship species, such as giant pandas, big cats, monkeys, gibbons, dolphins and ungulates, are afforded additional protection. After the outbreak of the COVID-19, China's top legislature immediately made the decision to ban wildlife consumption throughout the country, crack down on illegal wildlife trade, and increase promotion of environmental protection. Subsequently, the government updated National Catalogue of Livestock and Poultry Genetic Resources in 2020, and Lists of Wildlife Under Special State Protection in 2021, with number of protected species increased from ~500 to ~1500, covering more threatened species (Table 1).

This direct regulatory protection of wildlife is supplemented by a large portfolio of measures designed to protect habitat in support of wildlife. Although China had a relatively late start in developing its Protected Area (PA) system, it has already surpassed the Aichi Target 11 of 17% of terrestrial and inland water. By the end of 2019, China had established 11,800 PAs, covering about 18% of its entire land surface (Fig. 2a) and 89% of species under special state protection [3]. Nature reserves are afforded the highest level of protection and have increased rapidly from 1990 to 2007, currently covering about 15% of the land surface (Fig. 2b). Other types of PAs—including scenic spots, forest parks, geological parks, wetland parks, and desert parks— have also been established to meet multiple conservation goals (Fig. 2c) and are integrated with the PA system to protect China’s natural heritage in a wider sense.

China supplements habitat protection with other measures such as eco-restoration and eco-compensation. Two of the world’s largest initiatives—the Natural Forest Protection Project and the Grain to Green Program, provide economic incentives for human communities to protect and restore habitat in support of wildlife conservation. Moreover, these *in situ* efforts have been supported by a growing *ex-situ* conservation portfolio advanced by the establishment of over 240 zoos and about 250 breeding centers [3]. Several reintroduction projects have been successfully established for the giant panda, Pere David's deer, crested ibis and Chinese alligator. National wildlife monitoring networks have been established, and national evaluation of threatened species have been implemented, which greatly improve the scientific basis for decision makings. Considering the severe impact of human activities on fresh water and oceanic biodiversity [4], China has implemented a 10-year fishing ban in pivotal waters of the Yangtze River and summer fishing moratorium in oceans.

With the implementation of these national laws, PAs, and conservation projects (Fig. 1), a number of species have experienced population increases and habitat expansion, and more than one hundred mammalian species improve the national threatened status [5]. Some flagship species such as the giant panda, snow leopard, Tibetan antelope and crested ibis, have recovered from the brink of extinction, and been downlisted from “Endangered” to “Vulnerable” or from “Critically Endangered” to

“Endangered” by IUCN.

Combating wildlife trade

Significant headway has recently made major inroads into combating wildlife trade in China. To further mitigate impacts on Chinese wildlife from international trade, China has proposed adding endemic species for protection under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), providing additional protections for ~830 animal species. Trade ban on tiger bones and rhino horns has been implemented since 1993 (Fig. 1). The last few years have witnessed a large shift in regulatory activity, with several trade-related regulations and enforcements established (Fig. 1): wholesale bans on elephant ivory and all rhino and target products have recently been supplemented with a full ban on international trade in live wildlife. The Inter-Ministerial Joint Conference for Combating Illegal Wildlife Trade comprised of 25 ministries was established to combat illegal wildlife trade, indicating China’s intolerance of wildlife trafficking and determination to crack down on illegal wildlife trade. Moreover, China has increased collaboration with other nations to counter wildlife trafficking and multilateral wildlife law enforcement operations. In 2014 a law enforcement activity dubbed “Cobra II”, wildlife officials, customs, and police officers from 28 countries collaborated in the investigation of more than 350 cases, leading to the arrest of ~400 suspects.

Corporate social responsibility and conservation practice

Another recent development in China is the rise of corporate social responsibility and contributions to biodiversity conservation. Roles have varied across different industries, but corporations have begun supporting a number of conservation initiatives, including monitoring at-risk species and natural resources, establishing breeding centers, developing conservation breeding and reintroduction programs, creating charitable foundations to promote wildlife conservation, establishing green industrial supply chains to promote eco-friendly products, developing digital technological innovations to facilitate biodiversity conservation [6]. The Alipay Ant Forest project is a good illustrative model of corporate involvement in conservation. Launched in 2016 by Alibaba’s Ant Financial Services Group, this program enlists public participation to

reduce their carbon footprint and support tree planting. By 2020 more than 500 million users had participated, resulting in 122 million trees planted in arid and semi-arid areas in China. These achievements earned the program top honors for the United Nations' environmental action category. In 2017, a consortium of 26 organizations including SEE Foundation and the Alibaba Foundation launched the "Commonwealth Nature Reserve Alliance" to enlist the public to protect 1% of the country's land area by 2030. By the end of 2019, more than 140 million people have contributed to the establishment of 39 PAs, covering an area of 7,630 km², 0.079% of the country's land area.

Community participation and traditional knowledge

Community-based biodiversity conservation initiatives are another area of growth in China. The public has been engaged through surveys of environmental beliefs and attitudes, engagement in the establishment of natural protection zones, and citizen science, as well as broad environmental education initiatives. Traditional belief has also been enlisted in the service of biodiversity conservation. Community Conserved Areas (CCA), like Feng Shui Forests, capitalize on spiritual beliefs to protect sites with religious significance or mitigate exploitation of resources protected by religious or cultural taboos. These CCAs are typically small in size but may contain key habitats for endangered species, or serve as corridors connecting larger PAs facilitating wildlife dispersal or migration. Community engagement in these PAs leads to better protection within sacred mountains than outside [7].

CHALLENGES AND PERSPECTIVES

Top-level design of protected area

The early construction of PA in China aims to rescue species from extinction. Although areas of PAs greatly increase in past decades, the ecosystem integrity and structure connectivity are not well addressed. The lack of top-level design has resulted in problems such as spatial mismatch of PAs and wildlife, spatial overlap of different types of PAs, fragmentation and isolation of PAs, and ineffective management [8]. Terrestrial nature reserves in China capture only 17.9% and 16.4% of the available habitat area for threatened mammals and birds, and even worse, 10.0% and 8.5% for amphibians and reptiles [9]. Marine PA network needs much more attention in both area

and connectivity [10].

Currently, China is establishing a system of protected natural areas with national parks as its mainstay, supported by nature reserves as the foundation and complemented with various natural parks. Moreover, Ecological Conservation Redline which is coordinated and aligned with other land-use-planning frameworks is also underway. These top-level designs will integrate and optimize existed PAs to cover more key areas for wildlife and ecosystem services, and expand to improve niche representation. In addition, the establishment of marine national park is urgently needed to strengthen the protection of marine biodiversity [10]. Meanwhile other type of lands with conservation value, such as farmland, should be incorporated into protection plans [11]. Transboundary conservation reserves and corridors should be established for migratory species that traverse international borders like the red panda, Asian elephant, the Myanmar snub-nosed monkey, and eastern black crested gibbon, to build a shared future for all life in transboundary areas.

Science-based conservation and management

Lack of information about the demographic history, genetic diversity and adaptive strategies of endangered species has limited conservation solutions and recovery actions. A notable counterexample is the giant panda, where science-informed policy and management contributed to downlisting of the species from Endangered to Vulnerable [12]. Therefore, future policy and management decisions should rest on the quality of the underlying science. A multi-disciplinary scientific committee is needed to provide analysis, assessment and recommendations for decision-making, such as revising wildlife protection laws, setting conservation targets, and formulating national conservation programs. Taxonomic changes among listed species should be addressed timely, and lists of protected species requires regular updating so that gaps can be closed, and that management interventions can be established for all species at-risk. Besides the science-based management of common species should be enhanced. With the implementation of national projects, and the absence of large and medium-sized carnivores, the rapid growth of some herbivores, such as wild boar, are adversely affecting ecosystem stability. Scientific management intervention is required for species

187 exceeding carrying capacity.

188 **Long-term monitoring, information sharing and evaluation**

189 Although several wildlife monitoring networks are running, monitoring gaps and
190 overlaps are common in practices, and indicators, methods and guidelines for regulating
191 these networks are inconsistent due to the lack of top-level design. Most importantly,
192 monitoring data could not be fully shared, integrated and analyzed to guide
193 management decisions and policy. In addition, although the terrestrial wildlife epidemic
194 monitoring network which composed of 350 national, 768 provincial, and many
195 county-level monitoring stations has also been established for more than ten years, the
196 capacity of wildlife disease control and monitoring is still insufficient.

197 To fill the gaps, further optimization and integration of current wildlife monitoring
198 networks are needed where information could be freely shared. New technologies such
199 as low-altitude remote sensing by unmanned aerial vehicles or small satellites, and
200 thermal infrared remote sensing should be incorporated with traditional monitoring
201 methods to obtain fine-scale integrated observations for better understanding of
202 dynamic changes in wildlife and habitat. Besides species diversity, genetic diversity
203 should also be monitored for the formulation of scientific and reasonable conservation
204 strategy [13]. Given wildlife-borne infectious disease is an important driver of species
205 decline and extinction [14], new scientific frameworks such as updating current
206 monitoring systems, establishing national key laboratories and genetic resource banks
207 for detection of zoonotic diseases in the early stages are required. Furthermore, China
208 has implemented many conservation programs, however, an indicator-based scientific
209 index system to evaluate the effectiveness of these programs has not been established.
210 Documenting outcomes of management interventions and protective measures on a
211 regular basis is needed to guide the design and implementation of future conservation
212 measures.

213 **Promote increased contribution by citizens and corporations**

214 Citizen science and other forms of public engagement have great potential for
215 raising public awareness, advancing scientific knowledge, and improving natural
216 resource management and environmental protection [15]. Chinese policymakers,

researchers and academics should make greater use of these forms to leverage public involvement in conservation science and practices, promoting the internalization of environmental ethics and cultivating ambassadors that champion conservation causes. CCAs are often more cost-effective compared to nature reserves because compliance with environmental stewardship comes from the community's attitudes rather than governmental regulation. The government should incorporate and promote this community-based approach and education initiatives whenever feasible. Further, China now has good models for corporate social responsibility and green practices (e.g., Alipay Ant Forest), and these approaches should be promoted widely and adopted by other corporations. Corporate uptake of biodiversity conservation initiatives, awareness campaigns, green industrial chains, and green products will be vital for the future of China's natural heritage.

CONCLUSION

Progress in wildlife conservation and management in China is founded on the establishment of a legal framework and the implementation of laws, regulations, and science-based conservation programs during the past 40 years. Population recovery and reintroduction of some flagship species, and recent intensified efforts to combat illegal wildlife trade set a good precedent for others. However, the effective conservation and management of wildlife still presents challenges, many of which mirror challenges faced around the globe. China has the good fortune of a long historical legacy of human-nature coexistence in the philosophy of Unity of Nature and Man. Conservations should work to mainstream this belief system to promote urgently needed progress in biodiversity conservation. The Ecological Civilization building on this historical legacy, provides an opportunity for the government to leverage people's beliefs to meet the conservation challenges articulated here. We believe that ancient Chinese beliefs have relevance today, and will help China and other countries to realize the harmonious coexistence of humankind and nature to build a shared future for all life on earth.

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Conflict of interest statement. None declared.

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Figures and Figure legends

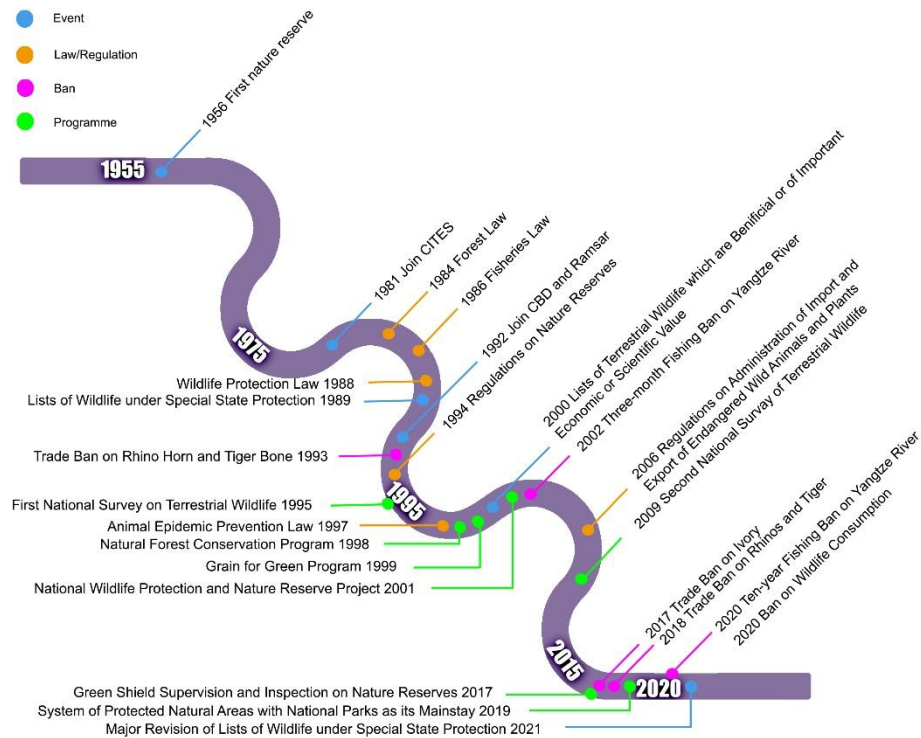


Figure 1. Timeline of Laws/Regulations (orange circle), national programs (green circle), bans (purple circle), and big events (blue circle) related to wildlife conservation and management in China.

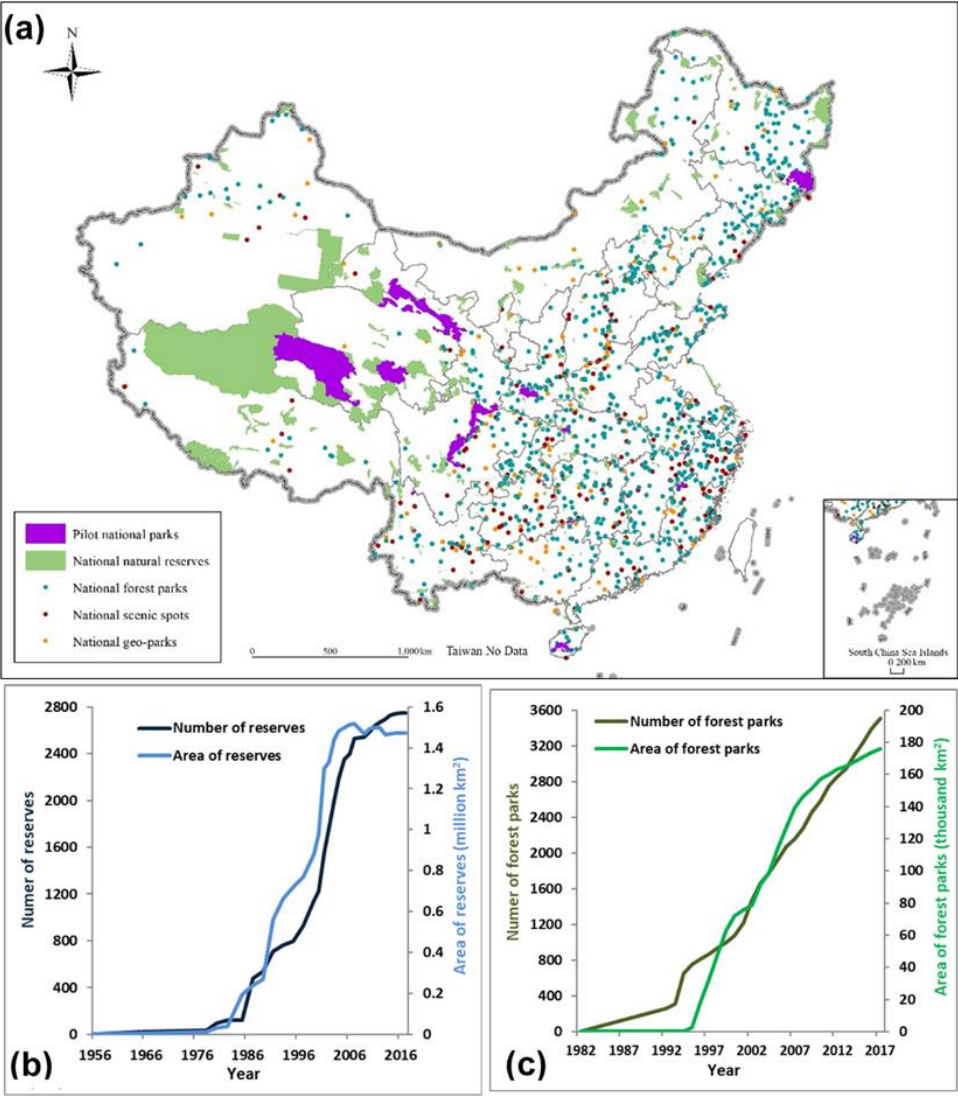


Figure 2. Distribution, area and number growth of major types of protected areas in China. (a) Distribution of major types of protected areas; (b-c) Area and number growth of nature reserves (b) and forest parks (c).

Table 1. Number of animal species included in old (1989) and updated (2021) Lists of Wildlife Under Special State Protection (WSSP) and threatened species in China Biodiversity Red List which are not included in WSSP. Data source: China Biodiversity Red List; CITES Appendices in China (Species+ and Chinese Version of CITES Appendices (enter into force on Nov, 26, 2019)); Ping & Zeng (2020) Changes in nomenclature of animals included in Lists of Wild Animals under Special State Protection in China and impacts on wildlife conservation. SCIENTIA SINICA Vitae. 50(1): 33-43.

| Taxa | I | | II | | Total | | Threatened species Not included [Number(ratio)] [#] | |
|--------------|------------|------------|------------|-------------|------------|-------------|--|---------------------|
| | Old | Updated | Old | Updated | Old | Updated | Old | Updated |
| Mammal | 68 | 99 | 90 | 86 | 158 | 185 | 69 (38.76%) | 65 (36.52%) |
| Aves | 43 | 92 | 204 | 302 | 247 | 394 | 67 (45.89%) | 9 (6.16%) |
| Reptile | 6 | 19 | 11 | 83 | 17 | 102 | 119 (86.86%) | 78 (56.93%) |
| Amphibian | 0 | 7 | 17 | 86 | 17 | 93 | 167 (94.89%) | 110 (62.5%) |
| Fish | 4 | 10 | 11 | 149 | 15 | 159 | 282 (95.59%)* | 234 (79.32%)* |
| Invertebrate | 13 | 14 | 25 | 480 | 38 | 494 | | |
| Total | 134 | 241 | 358 | 1186 | 492 | 1427 | 704 (75.43%) | 496 (53.22%) |

[#] Threatened species in China Biodiversity Red List included those species assessed as Critically Endangered, Endangered and Vulnerable.

* Only freshwater fishes are included in China Biodiversity Red List.