POLICY PERSPECTIVE

Strengthening China’s national biodiversity strategy to attain an ecological civilization

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Abstract
Biodiversity conservation is essential for realizing China’s new vision of an ecological civilization. China has been implementing numerous massive ecological sustainability and protected area (ES&PA) programs across the entire country. These programs have greatly restored degraded ecological environments, improved provisions of critical ecosystem services and increased rural livelihoods. However, despite the general improvements in environmental quality, the trend of rapid biodiversity loss has not been significantly reduced. We found that most of the current ES&PA programs lack explicit biodiversity goals, and thus have limited contributions to the conservation of biodiversity. Given the limited resources available for and huge investments associated with these programs, achieving greater biodiversity gains under them is the most cost-effective way to conserve biodiversity. We recommend six strategies for strengthening the country’s biodiversity conservation, that is, strengthening biodiversity in ES&PA programs, PAs as the core, integrating biodiversity and ecosystem services, delivering effective monitoring, broad inclusiveness of stakeholders and mainstreaming biodiversity. These strategies also highlight China’s priorities for achieving significant progresses toward the Strategic Plan for Biodiversity 2011–2020, and should be important options for developing China’s post-2020 biodiversity framework.

KEYWORDS
biodiversity conservation, ecological civilization, ecological sustainability, ecosystem services, environmental investment, governance, habitat restoration, mainstreaming biodiversity, protected areas, systematic conservation planning

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1 | INTRODUCTION

Since 2012, China has highlighted ecological civilization as a long-term national strategy for promoting sustainable development (Lü et al., 2017). An ecological civilization aims at achieving harmony between people and nature (Liu et al., 2018) by pursuing green development and guiding the transformation of production methods and lifestyle of the entire society (UNEP, 2016). Its key tenets include “the need to respect, protect and adapt to nature; a commitment to resource conservation; environmental restoration and protection; recycling; low-carbon use; and sustainable development” (Xinhua, 2017). China is one of the most biodiversity-rich countries in the world (Liu et al., 2003). Biodiversity is essential for promoting healthy ecological environment and providing various ecosystem services vital to human well-being. This is particularly important in China because about half of its population lives in rural areas and directly depends on ecosystem services from natural ecosystems (Liu et al., 2018). Strengthening biodiversity and environment protection is at the core of China’s policy for developing an ecological civilization (Lü et al., 2017).

China has been implementing a portfolio of national ecological sustainability and protected area (ES&PA) programs (Bryan et al., 2018; Zhang, Luo, Mallon, Li, & Jiang, 2017). Some are dedicated to protect biodiversity, such as Nature Reserves and National Parks. But many primarily aim at recovering degraded environments and improving human well-being, and they often lack explicit goals for the conservation of biodiversity (Bryan et al., 2018; Wu, 2016). Some of China’s ES&PA programs are among the world’s largest, and they together have achieved remarkable outcomes, with measurable benefits for ecosystem services, rural development, and poverty reduction (Bryan et al., 2018; Ouyang et al., 2016). Mostly since 1998, China has invested US$ 378.5 billion (in 2015 US$) for 16 sustainability programs, covering 65% of China’s land and involving over 500 million people (Bryan et al., 2018). The six ecosystem services of national importance increased between 2000 and 2010, with food production having the largest increase (38.5%), followed by carbon sequestration (23.4%), soil retention (12.9%), flood mitigation (12.7%), sandstorm prevention (6.1%), and water retention (3.6%; Ouyang et al., 2016). Recently, China seeks to optimize spatial land-use patterns by developing the Areas of Principle Functions (UNEP, 2016). The Ecological Redline Areas are also established to sustain important ecological functions, biodiversity and ecosystem services (Bai et al., 2018). The effective implementations of these two zoning programs are among the priorities for building an ecological civilization (UNEP, 2016).

However, despite the general improvements in environmental quality, the provision of biodiversity habitat decreased by 3.1% between 2000 and 2010 (Ouyang et al., 2016). The latest Red Lists of China’s Biodiversity indicate that >20% of vertebrates and >10% of higher plants are threatened or extinct (Jiang, 2016; Liu et al., 2018). Large conservation gaps still exist (Xu et al., 2018), and more than one third of the forest Nature Reserves in southwest China have failed to curb deforestation (Zhao et al., 2019). Therefore, there is plenty of room for cost-effectively achieving greater biodiversity outcomes across China’s ES&PA programs (Bryan et al., 2018; Hua et al., 2016). Here, we recommend six strategies for strengthening the country’s biodiversity conservation (Figure 1). Specifically, we suggest applying a framework of systematic conservation planning (Margules & Pressey, 2000) that simultaneously targets biodiversity and ecosystem services to determine the optimal network of priority areas for implementing ES&PA programs.

2 | SIX STRATEGIES FOR STRENGTHENING CHINA’S BIODIVERSITY CONSERVATION

2.1 | Strengthen biodiversity goals in ES&PA programs

We derived the first three primary goals for each of China’s 16 ES programs and 11 PA categories from Bryan et al. (2018), Zhang, Luo, Mallon, Li, & Jiang (2017), and Peng, Fan, Xing, and Cui (2018). A total of 16 different goals were recognized, and the primary goals for each program range from one to three. Only four of the 16 ES programs and six of the 11 PA categories include explicit biodiversity goals (Figure 2). This indicates that most of China’s environmental investments lack a direct link to biodiversity conservation (Wu, 2016). We call for a comprehensive investigation of opportunities to improve biodiversity conservation under the ES&PA programs.

Biodiversity should be particularly emphasized in habitat restoration programs because biodiversity affects ecosystem functions (Liu et al., 2018). A recent analysis highlights the importance of incorporating multiple dimensions of biodiversity features (e.g., species, functional, trophic, and genetic diversity) for restoring ecosystem functions at a high rate (Hughes, Grabowski, Leslie, Scyphers, & Williams, 2018). Active restorations usually do not result in more complete or faster recovery than passively recovering ecosystems (Jones et al., 2018). This implies that restoring through natural regeneration should be a priority, whereas active restorations could overcome specific obstacles to recovery (Jones et al., 2018). Reforestation and afforestation programs are critical active restoration activities in China. For instance, the Grain for Green Program and Shelterbelt Development Program—Three North have greatly increased forest cover by adding 60.15 million hectares from 1998 to 2014 (Bryan et al., 2018). However, the increased forest cover is predominated by
nonnative, single-species plantations, and the afforestation in regions that did not originally support forest (Xu, 2011). Such forests have less contributions to biodiversity conservation (Wu, 2016). As demonstrated in Sichuan, compared to native forest, compositionally simple reforestation has 17–61% and 49–91% fewer bird and bee species (Hua et al., 2016). Greater biodiversity gains can be achieved at low cost by promoting native, mixed plantations over nonnative, fast-growing monocultures, and by prioritizing the restoration of native forests (Hua et al., 2016).

2.2 | PAs as the core

Many of China’s PAs are understaffed, underfunded, poorly managed and degrading, and thus upgrading existing PAs is a priority (Zhang, Luo, Mallon, Li, & Jiang, 2017). PA systems should significantly reduce human pressures and threats to biodiversity (Schulze et al., 2018). Effective conservation of China’s PAs requires a threat-driven management to address the primary challenges within and beyond PAs, such as habitat loss/degradation, resources overexploitation and pollutions (Liu et al., 2018). Further efforts are imperative to understand the conservation implications of PA dynamics. From 2005 to 2014, 403 Nature Reserves (totally four million hectares) were degazetted in China; and the boundary adjustments in 57 national Nature Reserves caused a loss of 2.8 million hectares (Ma et al., 2019). Moreover, China’s PA system still cannot efficiently represent its biodiversity. Xu et al. (2018) found that 291 of the 552 key counties for species conservation have <10% PA coverage. The distribution of Nature Reserves (mostly allocated in western China) mismatches that of threatened species’ habitats (much in eastern China; Xu et al., 2017). A top-down process of systematic PA designation is lacking, and most PAs are established by local governments in an opportunist manner (Xu et al., 2018). We propose to apply systematic conservation planning to improve the representativeness of PAs (Lü et al., 2017; Xu et al., 2018).

We suggest PA governance improvements in administration, management categories, investment and land tenure. China has established a complex PA system including 11 different categories under the jurisdiction of nine ministries (Figure 2; Zhang, Luo, Mallon, Li, & Jiang, 2017). The effectiveness of China’s PAs is seriously compromised by administrative conflicts (Xu, Zhang, Liu, & McGowan, 2012). For instance, many different categories of PAs designated by different ministries overlap spatially and have conflicting management goals. Zhangjiajie in southern China is designated as four PA categories (Nature Reserve, Forest Park, Scenic Spot and Geopark) by the Ministries/Administrations of Agriculture, Forestry, Housing and Urban-Rural Development, and Land and Resources, respectively (Zhang, Luo, Mallon, Li, & Jiang, 2017). At least 102 Scenic Spots overlapped with Nature Reserves in 2009, with 18 of them having the same boundaries as Nature Reserves (Xu, Zhang, Liu, & McGowan, 2012). Therefore, a centralized management agency for all PAs is crucial for eliminating conflicts (Li, Wang, Axmacher, Zhang, & Zhu, 2016). Fortunately, China is developing a coherent PA management system and has established a new National Park Administration in April 2018.

The lack of a unified PA classification system has caused many problems, such as confused PA categories, vague
management goals, spatial overlaps and difficulties in international communications (Peng, Fan, Xing, & Cui, 2018). The National Park Administration should lead to develop this classification system and incorporate all existing PAs into it. Three general PA categories have been proposed based on primary management objectives, including National Parks (for large intact natural ecosystems), Nature Reserves (for important ecosystems, wildlife and natural relics) and Natural Parks (for scenic landscapes; Peng, Fan, Xing, & Cui, 2018). The incorporation of existing PAs must follow a rigorous process that ensures a comprehensive assessment of each PA’s management objectives, socioecological settings and conservation values. The classification system should align with international standards (e.g., IUCN PA management categories) in order to facilitate the reporting of China’s conservation progress globally.

China’s investment in PAs has greatly increased with its rapid economic growth. Funding for Nature Reserves has increased on average by 13.7% per year since 2001; the average total expenditure on national Nature Reserves was US$ 5.50/hectare in 2009, and 65% of national Nature Reserves received sufficient investment (Zhang, Luo, Mallon, Li, & Jiang, 2017). However, China’s policy, requiring local governments to bear the costs of local PAs, means many are underfunded, as most PAs are located in underdeveloped regions with insufficient conservation funds (Zhang, Luo, Mallon, Li, & Jiang, 2017). We recommend the central government provide adequate funding for all PAs because they deliver public benefits. The National Park Administration is in a good position to enact this policy recommendation. Additional resources could be raised from domestic/international nongovernmental organizations (NGOs; Liu et al., 2003).

FIGURE 2  The goals of China’s ecological sustainability and protected area (ES&PA) programs. The first three major goals for each program were listed. The goals for the 16 ecological sustainability (ES) programs and the 11 categories of protected areas (PAs) were adopted from Bryan et al. (2018), Zhang, Luo, Mallon, Li, & Jiang (2017), and Peng, Fan, Xing, & Cui (2018). In total 16 goals were recognized. The programs in bold have an explicit goal for protecting biodiversity.
China’s land tenure arrangements often plague PA effectiveness (Xu & Melick, 2007). Many PAs cover large areas of collectively owned land, which has been used by local people for generations (Zhang, Luo, Mallon, Li, & Jiang, 2017). Restriction on traditional livelihood practices triggers conflicts between local residents and PA agencies. Reforming land tenure arrangement is unlikely, but some policy initiatives, such as land leasing, land swapping, payments for ecosystem services and conservation easements, can be applied to promote conservation on collectively owned land.

2.3 | Integrate biodiversity and ecosystem services

Researchers have advocated integrating biodiversity and ecosystem services in conservation planning, assessment and natural resource management (Lü et al., 2017). This integration ensures mutual improvements in the well-being of both people and biodiversity, and improves the cost-effectiveness of environmental investments (Chan, Shaw, Cameron, Underwood, & Daily, 2006). Most of China’s ES&PA programs have a dominant focus on either securing ecosystem services or protecting biodiversity (Figure 2). As a result, ecosystem services-focused programs often provide less benefits for biodiversity, such as reforestation of nonnative, fast-growing monocultures (Hua et al., 2016; Xu, 2011), whereas Nature Reserves mismatch the key areas for securing ecosystem services (Lü et al., 2017; Xu et al., 2017). Nature Reserves cover only 6.7% of the conservation priority areas for critical natural capital (Lü et al., 2017) and 10.2–12.5% of the source areas for four key regulating services (Xu et al., 2017).

Given the prevailing spatial trade-offs between ecosystem services and biodiversity, a systematic conservation planning process integrating biodiversity and ecosystem services should be applied to identify the optimal locations for implementing ES&PA programs. It will enable these programs to cost-effectively achieve goals on both nature and people. Such integrated planning could improve the public benefits provided by a PA system, and thus promote the scientific foundations of ecological compensation, which helps to achieve the win-win goal of nature conservation and poverty reduction (Chan, Shaw, Cameron, Underwood, & Daily, 2006).

2.4 | Deliver effective monitoring

Effectiveness monitoring is essential to guide the adaptive governance of environmental programs. Numerous studies have assessed the performance of ES&PA programs in biodiversity conservation, ecosystem services provision and socioeconomics (Bryan et al., 2018). However, most assessments have been conducted at large scales using approximate modeling methods and indirect coarse-resolution data (e.g., satellite imageries). Problems in data accuracy and modeling methods may lead to unreliable conclusions, and the coarse large-scale assessments make it difficult to refine program implementation through learning. For instance, satellite data cannot monitor changes in biological composition and most ecosystem functions (Tong et al., 2018). A comprehensive and robust peer-reviewed quantitative evaluation of the effectiveness of ES&PA programs is needed (Bryan et al., 2018).

Many parameters for modeling the dynamics of biodiversity and ecosystem services can only be established through long-term monitoring. Satellite imagery with higher temporal-spatial resolution in combination with field surveys usually provides a cost-efficient approach for local-scale studies (Tong et al., 2018). The Chinese government has carried out many long-term ecological surveys and established impressive databases. These, however, are scattered across different agencies and rarely used in decision-making. We call for the creation of centralized publicly available databases and broad involvement of independent scientists in the analysis of these data.

2.5 | Broad inclusiveness

Successful ES&PA programs need to engage a wide range of stakeholders, from government agencies, local communities, NGOs, academics, private businesses and other members of the general public (Bryan et al., 2018). Such inclusiveness is essential to represent the interests and values of all stakeholders. China’s ES&PA programs follow a top-down administrative system. The central government initializes these programs and sets high-level objectives, leaving the responsibility for design, implementation, supervision and monitoring first to relevant ministries and then to provincial/local government departments (Bryan et al., 2018). Effective coordination and communication are, therefore, critical amongst both top-down government agencies and agencies at the same level.

Local communities are directly affected by ES&PA programs and often have to change their traditional livelihoods. Indigenous knowledge of natural resource management is invaluable—for instance, the sacred natural sites can contribute to maintaining biodiversity and ecosystem services (Xu & Melick, 2007). Moreover, consideration of the heterogeneity and dynamics of local socioecological systems is essential for achieving the long-term success of these programs (Bryan et al., 2018), and local communities’ legitimate concerns must be respected and addressed (Liu et al., 2003). Full involvement of local people in decision-making and the establishment of co-management institutions are time-tested mechanisms for delivering the best long-term outcomes. Direct compensation is essential when livelihoods are affected by forgoing resource-use activities. Governments...
2.6 | Mainstream biodiversity and its critical role for ecosystem services

Mainstreaming biodiversity across government and society for addressing the underlying causes of biodiversity loss is the first strategic goal in Strategic Plan for Biodiversity 2011–2020, and the strategic goal D requires to enhance biodiversity for providing essential ecosystem services through conservation and restoration (CBD, 2010). China has initiated the process of mainstreaming biodiversity since its signature of the Convention on Biological Diversity in 1992. The conservation of biodiversity and ecosystem services is becoming an important agenda for governments (Bryan et al., 2018). Biodiversity values have been preliminarily integrated into many aspects of national and local-level government affairs, such as economic development plans, institution constructions, legislations, land-use planning, environment impact assessments, and environmental protection policies (Zhang, Liu, & Li, 2015).

China’s policy toward an ecological civilization provides new incentives for mainstreaming biodiversity. An effective way is to incorporate biodiversity values into the performance appraisal system of governments, and make protecting biodiversity their day-to-day activities. Some local governments (e.g., Chongqing Municipality) have launched pilots since 2006 (Zhang, Liu, & Li, 2015), and now the central government has made conserving natural capital an essential indicator of government performance. Integrating biodiversity into land-use planning policies is a fundamental approach for mainstreaming biodiversity. For instance, China has launched numerous strategic spatial zoning programs (e.g., the Areas of Principle Functions) to optimize large-scale land-use patterns. Biodiversity and ecosystem services should be emphasized in these zonings as well as in finer-scale planning (Bai et al., 2018). Environmental impact assessment plays an essential role in safeguarding biodiversity. Although an environmental impact assessment system has been established, we suggest China embrace the standard mitigation hierarchy of avoid, minimize, remediate and offset for achieving no net loss of natural capital from economic development activities (Arlidge et al., 2018).

3 | CONCLUSIONS

Biodiversity serves as the backbone for realizing China’s vision of an ecological civilization by promoting healthy ecological environment and providing critical ecosystem services. Strengthening biodiversity goals in ES&PA programs is essential to cost-effectively maintain biodiversity across large scales. As a bulwark against rapid biodiversity loss, the PA system should be upgraded through increasing governance, management effectiveness and ecological representation. Win–win results for both nature and people could be achieved by integrating biodiversity and ecosystem services in environmental management. There is an urgent need for a robust assessment of the effectiveness of ES&PA programs in order to guide the adaptive governance of environmental investments. Moreover, effective participation of a wide range of stakeholders helps to ensure the success of biodiversity conservation, and mainstreaming biodiversity across government and society is a fundamental way to address the underlying causes of biodiversity loss. The six strategies also highlight China’s priorities for making significant progresses toward the 2020 Aichi Biodiversity Targets, and should be important options for developing China’s post-2020 biodiversity framework.

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