



Risk assessment and warning system for strategic biological resources in China

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The qualities of natural endowment and ecological capital that characterize biological resources make them strongly tied to the national economic and social growth of a nation. In addition to serving as the foundation for human production and living things, biological resources are crucial for industrial development and biotechnology.¹ All biological resources have significant strategic importance since they are an integral element of the ecosystem, offer potential for scientific significance and application value, and are crucial for maintaining biological genetic diversity, ecological security,

energy security, etc. Animals, plants, microbes, and pathogens play an essential strategic role in the generation and accumulation of living materials as well as the sustainable evolution of ecosystems.² From a global standpoint, developed nations have a long history of gathering, conserving, and evaluating strategic biological resources. They have also established a system for the conservation of biological resources (such as the 'National Animal Germplasm Program' of the United States, the 'Biomass Action Plan' of the European Union, the 'National BioResource Project' of Japan, etc.) that is

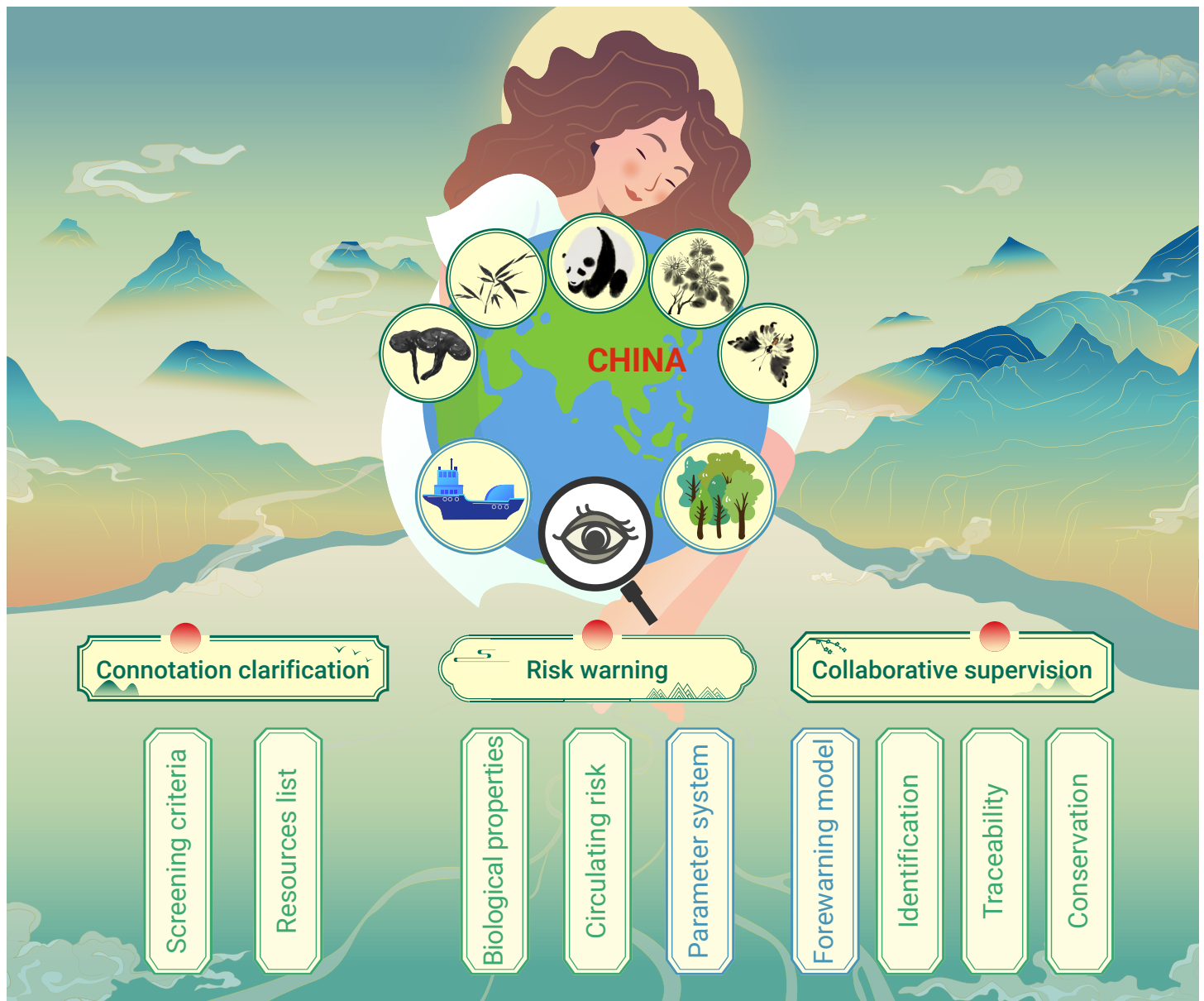


Figure 1. Roadmap and risk factors for the loss of strategic biological resources This initiative utilizes the collaboration of multiple research institutes to address the ongoing depletion of strategic biological resources in five key areas.



comparatively complete and protects a variety of global biological resources, including animals, pathogens, microbes, plants, and human genetic resources.³ However, because many regions are not hotspots of global biodiversity, there is little pressure on nations that are affected by resource loss, and more focus is placed on integrating and using resources across the world. As a result, there is less study on resource loss risk assessment and early warning. Other significant biological resources that are present locally are also being lost.

China, one of the most biodiverse nations in the world, has a long geological history and several biodiversity hotspots, which have produced the diverse ecosystem types. China has also produced an incredibly diverse array of animal, plant, microbial, and genetic resources. After years of development, China now has 316 plant conservation institutions, 96 animal conservation institutions, 90 microbial conservation institutions, and 6 viral conservation institutions covering various biological resources. The conservation capacity and research level have also been greatly improved. The resources for preserved germplasm cover 2,700 kinds of crops, 2,300 different kinds of trees, 9,500 various kinds of wild plants, more than 700 multiple kinds of live livestock and poultry, nearly 1,800 multiple kinds of aquatic animals, nearly 210,000 different strains of microbes, and nearly 20,000 different strains of pathogens.⁴ Although there has been some progress in China's efforts to collect and conserve biological resources, effectively preventing the loss of such resources remains a challenge. Incidents involving public security and customs systems are common, illustrating the ongoing issue (Figure 1). The unclear strategic significance of biological resources and the lack of reliable departmental cooperation contribute to this problem. For example, in 2005, Kunming Airport customs seized a shipment of domestic orchids from the luggage of a Thai tourist, along with 1,497 wild orchids from 13 different species, all of which are valuable species protected by domestic and international laws. Similarly, in 2006, the Guangdong Entry-Exit Inspection and Quarantine Bureau confiscated over 550 *Tylotriton shanjing*, an endangered wild animal (Level II).⁵

On March 6, 2023, scientists from ten Chinese institutions jointly launched the 'Research on Security Risk Assessment and Early Warning System of Important Strategic Biological Resources' program in Beijing, China. The participating institutions include the Institute of Zoology, CAS; Institute of Botany, CAS; Institute of Microbiology, CAS; National Institute for Viral Disease Control and Prevention, China CDC; Technical Center for Animal, Plant and Food Inspection and Quarantine of Shanghai Customs; Kunming Institute of Zoology, CAS; Kunming Institute of Botany, CAS; Research Center of International Inspection and Quarantine Standards and Technical Regulations of the General Administration of Customs; Academy of Military Medical Sciences, Academy of Military Science; and Nanjing Forest Police College. This initiative was launched in response to the pressing need for assessing the strategic significance of biological resources and protecting them. This project primarily carried out pertinent works for the serious situation of continuous loss of strategic biological resources in China through the cooperation of the aforementioned ten scientific research institutions (Figure 1), and based on the works of five aspects (animal resources, plant resources, microbial resources, viral resources, and related application departments: 1) conduct technical research on the system for assessing the security risk of significant strategic biological resources, including the identification of risk

factors that contribute to resource loss and the prediction of significant strategic biological resource loss risk, followed by the development of an early warning system for security risks; 2) identify the categories of local biological resources that are of strategic relevance, establish screening criteria for the strategic significance of biological resources, and then construct a list; 3) create a database with the morphological and genetic details of significant strategic biological resources and keep the data on biological resources; 4) build a technical system for the identification, traceability, and conservation of significant strategic biological resources. Develop technical methods for quick monitoring and identification of various types of resources. The objective of this initiative is to offer the technical assistance for preserving national sovereignty security of vital biological resources.

The identification, protection, and management of indigenous key biological resources are the primary objectives of this project, the first of its kind in the field of biosafety. The China Agricultural University, the National Space Science Center (CAS), and other institutions have also joined the proposal in addition to the aforementioned 10 institutions. The strategy of biological resources in various eras and backgrounds also has distinct definitions because of the continual outflow of biological resources, making this undertaking a long-term endeavor. We cordially invite additional Chinese local institutions to join us, starting with the fundamental roles of supporting social development and scientific research, and addressing the country's most urgent needs and the key economic battleground, by combining the necessary resources from scientific research departments and application departments to create a strategic biological resources network that includes more species and practical application scenarios. With the help of this system, the relative strategic biological resources of China could be collected, conserved, evaluated, transformed, and used sustainably to a greater extent, supporting the growth of the biological industry and offering solid scientific and technological support for the country's economy and society's long-term development.

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DECLARATION OF INTERESTS

The authors declare no competing interests.