CHINA

Biodiversity Conservation Action Plan

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National Environmental Protection Agency

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Ministry of Construction
Ministry of Finance
Ministry of Forestry
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State Oceanic Administration
State Planning Commission
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PREFACE

Each era in the human history has its own outstanding problems. The outstanding problems for our era are those that occur together with economic development, such as environmental pollution, losses in biodiversity and environmental degeneration, including diminution of vegetation especial forests, soil erosion, desertification, salination and decreased soil fertility. All these pose a threat to human survival and social progress.

Biodiversity means a myriad of diversity in animals, plants and microorganisms, their genotypes and variations on earth. Among the problems identified above, the one related to biodiversity, most likely to escape the attention of the human beings, is most important, since biodiversity provides not only the indispensable biological resources, but also the environment of biosphere for the human survival.

Biodiversity offers us raw materials for foodstuffs, fibers, timber, medicines and a variety of industries. The raw materials for food are of special importance because they can not be substituted by any synthetic products. Further, biodiversity renders its "service functions" in maintaining soil fertility and water quality, and is modulating climate. In view of global ecology, biological growth and metabolism actively control the earth surface temperature, the redox of ground surface sediments and pH values. These conditions suitable to human life, absent from the early period of long history of the earth, have been created during the abundant appearances of organisms, their growth and related interactive processes, since the palaeozoic era. For example, 20% of the current oxygen content in the earth's atmosphere is available for human respiration, thanks to photosynthesis by plants, while much lower content of oxygen in atmosphere existed in the early history of the earth. Scientists estimated that the oxygen currently available would be exhausted in several thousand years due to oxidation if without photosynthesis by plants.

Biological science, through the studies of paleontological history, has shown that any species, once becoming extinct, can not reappear, just as the case with dinosaurs which were unable to be regenerated after their extinction 60 million years ago. This has become a rule. Animals and plants can produce their offsprings because their cells contain genes which can be hereditarily translated (DNA - deoxyribonucleic acid). This is a complex and active substance which contains some billions of monomers (alkali

pairs). Life science is under research. In the foreseeable future, science can not artificially make such hereditary genes. If species in existence today on earth, the endangered species in particular, became extinct, human beings would lose biological resources probably most precious to the future generations.

Therefore, protection of life other than human beings and conservation of biodiversity on earth, particularly the endangered species, assume major strategic importance for our later generations and for scientific development. However, according to observations and statistics from scientists, species (including the intrinsic genetic resources) are becoming extinct or lost at a surprisingly fast rate. Some international scientists estimated that the current speed of species losses is faster by 1,000 -10,000 times than that of the natural extinction before mankind intervened (Wilson, 1988). In most of time in the evolution of life, the speed of species extinction is approximate to that of its formation. However, the current speed of extinction is over 1 million times faster than that of formation (May, 1988). Although scholars differ in their estimates, it is indisputable that biodiversity has been decreasing at an unprecedented rate, particularly in humid and tropical developing countries.

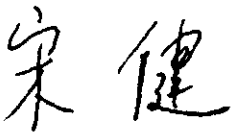
Some scholars estimated that the number of endangered species in China's temperate zone account for 10% of the total, and for more than 10% in tropical and sub-tropical areas. There are 4,000 -5,000 endangered high class plant species in China, occupying 15% -20% of the total. It has been preliminarily determined based on the consensus of China's biologists that the number of endangered species reaches 398 for vertebrates (7.7% of the total), and 1,069 for high class plants (3.4% of the total). On the whole, the situation is urgent. China is confronted with a tremendous and difficult task of biodiversity conservation.

Over recent years, the conservation of biodiversity has engaged broad attention of various countries in the world. The United Nations Conference on Environment and Development at Rio de Janeiro in 1992 adopted The Convention For Biological Diversity. China is among the earliest contracting countries to the convention, and is now undertaking her obligations in conservation biodiversity in the country. Prior to the Rio Conference, the Global Environment Facilities (GEF) had supported different countries and regions for the preparation of action plans for biodiversity conservation. China was the second country chosen for the support following Indonesia.

In 1992, under the support of the World Bank / the United Nations Development Program (UNDP), with collaboration of Dr. Lee Talbot, Science Consultant of the World

Bank, and other international experts, the National Environmental Protection Agency played a leading role in coordinating efforts made by ministries and agencies responsible for such fields as agriculture, forestry, ocean affairs and construction, as well as by the State Science and Technology Commission, the State Planning Commission, Ministry of Finance, Ministry of Public Security and Chinese Academy of Sciences. After two years' efforts in discussions, drafting and revisions, the finalized China's Action Plan For Biodiversity Conservation is now ready. This action plan will be a platform document for biodiversity conservation activities, offering important guidance in prompting the conservation by the entire society of the rich, multiplicate and distinct biodiversity of the country.

Biodiversity conservation is a legal obligation for governments at various levels, and a commitment by the whole society as well. This has been clearly provided for in the efforts by governments at various levels alone are far from enough. Public participation is more important. The publication of the present action plan provides good guidelines for the governments of different levels, scientific and technological workers and broad masses of the people.



Song Jian
State Councillor,
Chairman of the Committee for Environmental
Protection of the State Council

May 1994

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Biodiversity Conservation Action Plan Process in China

The Biodiversity Conservation Action Plan (BAP) for the Peoples' Republic of China is funded under the Global Environment Facility (GEF), through the United Nations Development Programme (UNDP), and with the World Bank as the executing agency. The in-country process is coordinated by the National Environmental Protection Agency (NEPA). Since responsibilities for biodiversity conservation, including research and management, are spread widely throughout the government, NEPA established a Leading Group (*see* inside front cover), composed of those agencies with significant biodiversity responsibilities, to provide overall supervision, direction and coordination.

Planning and preliminary arrangements for the BAP, including the action plan outline and proposed schedule, were undertaken in 1991. The GEF project itself was initiated in 1992. The process has involved wide national and international participation through a series of workshops, working groups and expert advisory groups. The first BAP Workshop, in February 1992, established criteria for determining the biodiversity significance of species and ecosystems, nationally and internationally, and the priority for their conservation in China. The second BAP Workshop, in November 1992, assembled for the first time national and international experts on Chinese biodiversity. The participants reviewed the state of knowledge about biodiversity in China that would be necessary for the action plan, developed detailed lists of Chinese ecosystems and species of national and international significance, and assigned priorities for needed conservation action.

The four-week drafting session held in February 1993. The participants reviewed the results of the November workshop and the separate drafts that had been prepared by each member of the Leading Group, and combined these into a single, consolidated draft. This draft was reviewed and amended at the BAP Workshop in April 1993. The present document has been further reviewed and revised by national and international experts and has subsequently been approved by Government.

The BAP is intended to be a living document, however—one that remains relevant to conditions that are constantly changing. Therefore, just as biodiversity conservation must be an ongoing endeavor, the status and trends of China's biodiversity must be continuously monitored, and the conservation programs outlined in this action plan periodically updated to meet the new conditions.

China's biodiversity is of great value to the Chinese people and to their economic and social development. But China's biodiversity is also of international importance, as it is a significant percentage of the world's species and ecosystems. Similarly, this action plan has dual importance. It is intended foremost to provide the basis for China's efforts to conserve its biodiversity. But the BAP process also is significant in that it marks the first time that scientists, managers and officials from all parts of China and from abroad have come together to pool their information, ability and effort toward conserving China's biodiversity. The nations signatory to the Biodiversity Convention are committed to developing a strategy to conserve their biodiversity, and China is one of the very first to do so. Therefore, this plan and the process through which it was created can serve as a model for others throughout the world.

INTRODUCTION

Biodiversity conservation is very closely related to the existence of all of our citizens, to the destiny of our nation, and to the future of our descendants. To enhance the nation's awareness of the critical importance of our biodiversity and its conservation is our urgent task of the highest priority. Faced by the constantly increasing impacts of environmental pollution and the ever increasing damage to the nation's ecosystems and species, we have no choice but to protect the environment. To protect the earth, to rescue green mountains, clean waters, blue skies, and fertile land on which the country's biological diversity depends, and to rescue our vast homeland so the Chinese nation can live and prosper from generation to generation is the most pressing matter of the moment that has already drawn the close attention of the Chinese Government. As Premier Li Peng stated at the third National Environment Protection Conference, "without more lasting and effective efforts all the achievements obtained in the past years might be offset by the ever growing environmental problems." Since we Chinese people love our motherland, we should take seriously the warning from damages the country's biodiversity has suffered. Since we are aware of our responsibility to our future generations, we should make our best efforts for the successful implementation of this Biodiversity Conservation Action Plan.

Biodiversity provides the basis for the survival of human societies and for their economic and social development. Conserving biodiversity and securing the sustainable benefits of its resources and services is an international task and an essential part of global efforts for environmental protection.

Biodiversity refers to all the earth's living organisms—the range of species of plants, animals and invertebrate life, their genetic makeup, and the ecosystems of which they are integral parts. It is generally understood that there are three main components of biodiversity: ecosystem, species and genetic diversities.

An ecosystem is the complex of living species and their non-living environment. All species are part of an ecosystem, playing a role in maintaining the system and at the same time relying on the system for its life-support. There is great diversity among ecosystems but all maintain ecological processes, including the cycling of the chemical elements necessary for life and maintaining the flow of energy between its components. Whether at the level of small ecosystems or the globe itself, these ecological processes are essential for the survival, evolution and continued development for all living things. Consequently, maintaining ecosystem diversity is essential to maintain species and genetic diversity.

Species diversity is the richness of the animals, plants and microorganisms that are the basis for human survival and development. Often, species resources are the objects of production activities for agriculture, forestry, animal husbandry, fishery and subsidiary industries, providing the necessary living material for mankind. With the continued development of medical science, more and more new biological substances of medical value are being discovered from wild species.

Genetic diversity refers to the variety of genes that are present within individuals, both within a single species and between species. The genetic makeup of a species determines its characteristics, including its fitness for survival in a particular situation, or its characteristics that make it useful to humans. Any given individual or species contains a large quantity of hereditary types, and in this context they can be considered individual gene banks. Genetic diversity includes genetic variability at the molecular, cellular and individual levels, and as such serves as the basis for evolution, adaptation, and species differentiation of living things. The more genetic variability a particular species has, the stronger will be its capability for adapting to the environment in which it feeds and breeds. The stronger the adapting capability of a species, the larger potential it has for evolution, and in this sense, genetic diversity has great practical importance for agriculture, forestry, animal husbandry and fishery production.

Biodiversity conservation can therefore have an important effect on the development of a given country or region, and can promote their economic prosperity. This is one of the reasons biodiversity conservation is of important concern to the international community.

China covers a vast territory of 9.6 million square kilometers, with the complex and varied geomorphology, climate and natural conditions that accommodate particularly rich species and ecological systems, and occupies an important biodiversity ranking in the world. According to preliminary statistics, Chinese plant species represent over 11 percent of the world total, among which over 240 species or genera are endemic to China. The number of reptile, bird, mammal and amphibian species in China account for over 10 percent of the world's total.

However, China's environment has suffered severe damage because of rapid population growth, irrational exploitation of resources, environmental pollution and ecosystem destruction, which has resulted in great loss of China's biodiversity. Research shows that about 200 varieties of China's wild plants are already extinct and another 5,000 varieties are on the verge of extinction. China's wild animals may be in a worse situation.

To meet the threats to its biological resources, the Chinese Government has made efforts over the years to protect nature and biodiversity. In the 1950s it started the development of natural reserves, which underwent rapid development during the 1980s. By 1991, China had set up more than 700 nature reserves, covering 56 million hectares in all, and accounting for 5.6 percent of its territory. These actions have helped to preserve some of its representative, typical and diversified natural ecosystems. In addition China has established many wild plant reserves and facilities for artificial breeding of wild animals, along with various kinds of gene banks, and it has developed a list of wild animals and plants which should receive protection, including 257 species of animals and 354 varieties of plants. A nature protection system has been established with laws and regulations that require the participation by relevant government departments, and some public educational campaigns have been initiated to raise public awareness.

But generally speaking, China is still in the primary stage of biodiversity conservation. It still faces many problems and difficulties, and has a long way to go to achieve effective conservation of its biodiversity. Among the key issues that need attention are:

- Laws and regulations for conserving biodiversity need to be improved, expanded and enforced;
- Management of existing nature reserves need to be strengthened and personnel need to be better trained; and the system of reserves needs to be significantly expanded to provide adequate coverage for all of China's ecosystems;
- Problems of coordination and effective cooperation among the various governmental agencies and levels involved with biodiversity conservation need to be resolved;
- Scientific research for biodiversity conservation needs to be expanded and improved;
- Problems of low funding for biodiversity conservation need to be resolved; and
- Lack of public awareness and support for biodi-

versity conservation needs to be dealt with.

As analysis of the present situation shows, the general trend of environmental pollution and ecological destruction has not been checked; and China's biodiversity will undoubtedly continue to be lost unless more effective action is undertaken. To provide the foundation for this action, the present action plan for biodiversity conservation has been drafted with the intention of placing the conservation actions within the framework of the nation's general socio-economic development plan. The action plan will also ensure systematic consideration of the problems described above.

By making full use of available existing data and knowledge, the action plan has been prepared in accordance with the guidelines and principles provided by the United Nations Biodiversity Convention, taking into account the realities of China's social and economic development and the present status of biodiversity conservation in the country. The resultant Biodiversity Conservation Action Plan for China consists of four parts. The first two describe the present status of biodiversity and the present efforts for its conservation, and the second two lay out the plan of action, the steps that China must take to conserve its biodiversity. The document is organized as follows:

Chapter 1 provides an assessment of the present status of biodiversity in China; it summarizes the richness of biodiversity in China, its present utilization, the extent to which it is threatened, and the urgency for strengthening its conservation.

Chapter 2 presents a systematic evaluation of current conservation measures: in-situ and ex-situ conservation facilities, laws and regulations, institutional capacity, scientific research, education and training, and international cooperative activities.

Chapter 3 presents the specific activities proposed for the direct conservation of China's biodiversity, or the direct protection of species and ecosystems. The objectives and tasks for this aspect of biodiversity conservation are presented in three levels of detail: objectives, actions, and in some cases, priority projects. The major objectives are outlined first. Then under each objective several important actions are listed, and for some of the actions priority projects have been determined. Six objectives altogether have been identified: establishing and improving the nature reserve network for the entire country; identifying and planning the conservation of wild species that are significant for biodiversity; planning the conservation of genetic resources of crops and domestic livestock; assessing the in-situ conservation of wild species outside reserve areas; establishing a nationwide information and monitoring system for the country's biodiversity conservation; and exploring ways and means for coordinating biodiversity conservation and sustainable utilization of biological resources.

Chapter 4 presents the actions needed to support the direct conservation efforts. This part includes a presentation of seven types of supporting measures: legislation and policy support; institutional measures; scientific research; technical extension; publicity and education; sources of funds; and international cooperation. This part also includes the steps and timing in implementing various actions and priority projects.

The Biodiversity Conservation Action Plan for China is of great importance for the Chinese nation itself. It is also an important component of the Chinese Government's program for fulfilling its obligations to the United Nations Biodiversity Convention; and it will have an important positive impact on global biodiversity conservation.

ACRONYMS AND DATA NOTES

BAP	Biodiversity Action Plan for China
BRIM	Biodiversity Research and Information Management
CAS	Chinese Academy of Science
CERN	Chinese Ecological Research Network
CITES	Convention on International Trade in Endangered Species
FAO	Food and Agriculture Organization (UN)
FRMC	Forestry Resources Monitoring Committee
GEF	Global Environment Facility
GIS	global information system
IBPGR	International Biodiversity Program of Genetic Resources
ICF	International Crane Foundation
IMO	International Maritime Organization
IPM	integrated pest management
IUCN	International Union for the Conservation of Nature and Natural Resources
MAB	Man and Biosphere Program
MFO	Ministry of Forestry
MOA	Ministry of Agriculture
MOC	Ministry of Construction
MOPC	Ministry of Public Security
MWR	Ministry of Water Resources
NBCIN	National Biodiversity Conservation Information Network
NEPA	National Environmental Protection Agency
NGOs	nongovernmental organizations (see data note)
SEPC	State Environmental Protection Commission
SEC	State Education Commission
SMA	State Medical Administration
SMB	State Meteorological Bureau
SOA	State Oceanic Administration
SPA	State Patent Administration
SPC	State Planning Commission
SSTC	State Science and Technology Commission
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Science and Cultural Organization
WWF	World Wildlife Fund for Nature

Data Notes

Dollars are US dollars unless otherwise specified.

In China the term *nongovernmental organizations* or *NGOs* refers to organizations that are not part of the central, regional or local governments, but that have some government affiliation, such as schools and research facilities. When the term is used to refer to international organizations, it will mean organizations with no formal affiliation to any government.

Chapter 1
PRESENT STATUS OF BIOLOGICAL DIVERSITY IN CHINA

Overview of China's Biodiversity

China is located in the southeastern part of vast Eurasia continent, between northern latitudes 4° and 53°, and eastern longitudes 73° and 135°. The total area of China is 9.6 million square kilometers, and the seawaters under its jurisdiction cover more than 3.0 million square kilometers. China's vast territory stretches 5,500 kilometers from north to south, spanning 50 degrees of latitude and 5 climatic zones—namely, the cold-temperate, temperate, warm-temperate, subtropical and tropical zones; and its eastern coastline is 5,200 kilometers from its western border.

Different combinations of air temperature and precipitation account for the big variation in climatic conditions in different regions of China. The southeastern part of China is located near the Pacific Ocean, receiving the southeastern monsoon of the Pacific Ocean, while its southwestern part borders the Indian sub-continent and is affected by the southwestern monsoon of the Indian Ocean. Due to the geographic locations, the eastern and southwestern parts of China are moist and wet. In contrast, the northwestern part of China extends into the deep inland of Eurasian continent and is very arid. Situated in between is a semi-arid transitional zone.

The complexity and variety of geomorphological types existing in China is unique in the world. The landscape of China rises in altitude from east to west, forming three gigantic steps, with mountains, plateaus and hills located mostly in the west, accounting for about two-thirds of the territory. The world's highest mountain peak, the Zhumulangmu peak, lofts on its southwestern border with an elevation of 8,848 meters, while the water level in the Aiding Lake in the Tulufan Basin is 154 meters below sea level—forming a dramatic contrast in altitude. Mountain ridges stretch along and across different climatic zones, giving rise to a large number of habitat types with clear differentiation of vertical zonation and making the country's natural conditions even more complex. In particular, the uplift of the Qinghai-Tibet Plateau in southwestern China has greatly influenced the landscape and climate of the surrounding areas.

Since the Tertiary Period or Cretaceous Period, China has had primarily a warm, moist subtropical and tropical climate, except for the arid area in Northeast China. In the Quaternary Glacial Period, China did not suffer from the northern continental glacier, though some areas were affected by mountainous glaciers and the cold glacial climate. Accordingly, many sanctuaries for the relict species and places of origin for newly developed isolated taxa were formed because the major part of China is southern and has diversified geomorphological conditions.

In summary, China covers a vast territory of complex climates and very diverse geography—mountain ranges, steppes, a large river network, many lakes, and a long coastline and vast seawaters to its east and south. This complicated mix of physical conditions provides diverse habitats for different animals and plants, for their feeding and breeding, and thus sustains the richness of biodiversity that makes China one of the megadiversity countries of the world.

Ecosystem Diversity

The main ecosystems in China can be divided into several types, such as forest, steppe, desert, farmland, wetland and marine ecosystems.

Forest ecosystems. The natural forests in China can be divided into coniferous, broad-leaved, and mixed coniferous and broad-leaved forests.

- Cold-temperate coniferous forests. These forests are mainly characterized by larch (*Larix* spp.), spruce (*Picea* spp.), fir (*Abies* spp.), and pine (*Pinus* spp.) forests. The sites of these forests are cold and moist, providing habitats for more than 200 species of wild animals, including more than 40 species of mammals and about 120 species of birds. Among them the *Gulo gulo, Alces alces, Cervus elapus, Felis lynx, Lepus timidus, Tetra parvitostris, Tetrastes bonasis, Lyrurus tetrix* and others are protected by the State as priority species.
- Temperate mixed coniferous and broad-leaved forests. These forests are characterized by the mixed Korean pine (*Pinus koraiensis*) and broad-leaved forests. After destruction they would be replaced by deciduous broad-leaved forests. They provide habitats for about 360 species of wild animals, including 53 species of mamm-als and 280 species of birds. Among animals protected with priority are *Panthera tigris altaica, Cervus nippon, Panthera pardus, Gulo gulo, Moschas moschiferus* and others.
- Warm-temperate deciduous broad-leaved and coniferous forests. Warm-temperate deciduous broad-leaved forests are characterized by oak (*Quercus* spp.) and oak mixed with many broad-leaved trees, such as *Betula* (spp.) and *Populus* (spp.). Warm-temperate coniferous forests include *Pinus tabulaeformis, Pinus densiflora, Pinus bungeana* and *Platycladus orientalis* forests. These forests contain about 2,000 species of wild plants and more than 200 species of vertebrates. Among animals protected with priority are *Panthera pardus, Macaco mulatta, Crossoptilon mentschuricum, Naemorhedus goral, Aquila chrysactos, Chrysclophus pictus* and others. The deciduous broad-leaved forests are severely degraded. Their secondary growth forests have become isolated islands, and their old age forests have already disappeared.
- Subtropic evergreen broad-leaved and coniferous forests. The subtropical areas in China have the broadest territorial extent in the world and the most favorable physiographic conditions. They cannot be compared with the narrow stretches of subtropical zones located in the Mediterranean region, Middle Asia, the South Asian subcontinent, Southwest Japan, the Florida peninsula, and East Australia.

  The forests in China's subtropical region are characterized by evergreen broad-leaved forests, associated with many kinds of coniferous forests. Evergreen broad-leaved forests are composed of *Fagaceae, Lauraceae, Magnoliaceae, Theaceae* and other families. Coniferous forests are characterized in the east by *Pinus massoniana*, and in the west by *Pinus yunnanensis* var. *tenuifolia*, and *Pinus armandii* forests. There are specific coniferous forests consisting of "live fossil" plants left over from the late Tertiary Period, including *Cathaya argyrophylla, Pseudolarix kaempferi, Metasequoia glyptostroboides* and *Taiwania Cryptomerioides*.

  The evergreen broad-leaved forests are growing sites for plants of 2,764 genera and 146,000 species and a great number of wild animals, with more than 1,000 species of vertebrates. More than 80 species of wild animals are protected with national priority in these forests, including *Ailuropoda melanoleuca, Rhiopithecus roxellanae, Panthera tigris amoyensis, Neofelis nebulosa, Budorcas taxicolor, Fielis temmincki*, and *Tragopan temminckii*.
- Tropical rain forests and seasonal rain forests. Tropical forests in China occupy only 0.5 percent of its territory, but contains 25 percent of the total number of species in the country. They are mainly distributed in the southwest part of Yunnan Province, Hainan island, south of Guangxi, and southeast of Tibet.

  Tropical forests in the Xishuangbanna region of Yunnan Province contain 15 percent of the total number of plant species and 27 percent of the total number of animal species in the country and provide habitats for many rare valuable

animal species such as *Elephas maximus, Bos gaurus, Hylobates concolor*, and the like.

Steppe ecosystems. Steppes in China can be divided into three types, namely, the temperate, the cold upland, and the mountainous steppe in desert zone. The temperate steppe is mainly distributed in the Inner Mongolian plateau, north part of loess plateau and west part of Songnen Plain. The steppes vary according to climate (from moist in the east to arid in the west) and to type (from meadow, to typical and then to desert steppe).

The meadow steppe is dominated by *Stipa baicalensis*, *Aneurolepidium chinense* and *Filifolium sibiricum*; the typical steppe is characterized by *Stipa grandis* and *Stipa krylovii*; and the desert steppe is mainly composed of *Stipa klemenzii* and small semi-shrub grasslands. In temperate steppes, there are an abundance of wild and domestic animals, of which *Procapra qutturosa*, fox and rodents are representative of the wild animals, and horses, oxen, cattle and sheep of the domestic.

The cold upland steppes are mainly located on the Qinghai-Tibet plateau. In the eastern semi-moist region of the plateau, the cold upland meadow develops, dominated by *Kobresia*, while the western arid region is covered by cold upland steppe, characterized by *Stipa purpurea* and *Carex moorcroftii*. The major wild animals in the cold upland steppe are *Pantholops hodgsoni, Panthera uncia*, and rodents; and the dominant livestock is *Bos mutus*. The mountainous steppes in desert areas are mainly distributed in the sites at high elevations in tall mountains such as the Altai, Tian, and Kunlun mountains, and are characterized by *Stipa capillata*. The major animals include *Gazelia subgutturosa*, roe deer, *Pseudols nayaur* and fine-wool sheep.

Desert ecosystems. Desert is a kind of ecosystem with low coverage of vegetation that develops where there is little precipitation, intense evaporation and extreme drought. It is mainly distributed in the northeastern part of China, and accounts for one-fifth of China's territory. Areg and Gobi Desert cover about 1 million square kilometers. China's desert can be divided into four types, according to growth forms of dominant plants: (i) arboreous desert, (ii) shrub desert, (iii) semi-shrub and small semi-shrub desert, and (iv) cushion-like small semi-shrub desert. The numbers of plants, animals and microorganisms in this ecosystem are relatively small and the food chain within the ecosystem is simple. The dominant plants are *Halozylon ammodendron, Haloxylon persicum, Ephedra przewalskii, Zygophyllum xanthosylon, Nitraria spaerocarpa, Reaumuria soongorica* and *Ceratodes*. Among animals, lizards (reptiles) predominate, not only in species numbers but also in population size. There are also some other animals such as *Rhombomys opimus, Equus hemionus*, and *Allactaga sibirica*.

Farmland ecosystems. China is one of the largest agricultural countries in the world, with farmland accounting for about 11 percent of total land area. The farmlands are distributed mainly in the southeastern part of the country.

Agriculture in China has a long history and its farmland ecosystems are full of varieties of plants and animals. There are more than 30 species of cultivated grain crops, 200 species of vegetables, and 300 species of fruit trees. The main grain crops include corn, wheat and rice. Corn is often intercropped with beans, and green manure crops are planted in rice paddies. In addition, cotton, rapeseed, peanut, beet, sweet potato, potato and vegetable constitute important components of cropland ecosystems., In cropland ecosystems, the intercropping of trees, fruit trees and crops forms different types of compound agro-forestry ecosystems. In addition there are small woodland patches, groves of farm trees, plantations of bamboo or other trees around houses, and lines of trees along roads. Farm ditches, streams and ponds are also associated farmland ecosystems.

Tea, mulberry, fruit and rubber plantations are also important components of farmland ecosystems in China. Tea plantations, distributed widely in subtropical areas, have the most clearly expressed features. Mulberry plantations are distributed in all provinces and autonomous regions except Tibet,

making the silkworm cocoon production of China the largest in the world. More than 20 species of fruit trees are planted all over the country, with different dominant varieties in the south and north.

Rubber plantations and tropical crops plantations are distributed only in tropical areas of the country. Interplanting of rubber trees, tea trees and other tropical crops forms multi-tiered rubber plantations.

Freshwater aquatic ecosystems (inland). Inland freshwater ecosystems are made up of lakes, rivers and swamps. China has a large number of lakes, which are predominantly large and medium-size, with a water surface area of more than 50 square kilometers each. They are distributed mainly in the Qinghai-Tibet plateau, Xinjiang and Inner Mongolia autonomous regions, Guizhou-Yunnan plateau, Jianghan Plain and Sanjiang Plain.

Lakes in China are rich in aquatic biological resources and species, providing habitats and the growing environs for different varieties of phytoplankton, zooplankton, aquatic vascular plants and freshwater fish. More than 770 species and subspecies of freshwater fish feed and breed in these lakes, of which about 690 species and subspecies are native to China. Many lakes are connected with rivers and are similar in species composition.

Swamps in China have a total area of 14.0 million hectares. They are mainly distributed in the northeast mountainous region, Sanjiang Plain and Norgai plateau. Their main kinds are larch (*Larix* spp.) peat bogs, sedge (*Carex* spp.) swamps and other herbaceous swamps. Swamps provide habitats for many species of water fowl, many of which are migrant birds. Many endemic and migratory species of water fowl find feeding, breeding and wintering grounds in swamps.

Coastal and marine ecosystems. China's seawaters cover three climatic zones (warm-temperate, subtropical and tropical), and are influenced by many oceanic currents, such as the continental coastal currents and the Kuroshio warm current. Broad intertidal flats and shallow shelfs stretch along the coastline, receiving more than 1,500 large and medium rivers. There are a number of coastal and marine ecosystems, such as the coastal flat, estuarian, coastal wetland, mangrove, coral reef, marine island and oceanic ecosystems.

The Yellow Sea and the Bohai Sea constitute the warm-temperate marine ecosystem, with coastal ice covers formed in the winter and clear seasonal changes in biotopes. Many marine animals such as *Phoca largha, Clupes harengus, Gadus macrocephalus, Mytilus edulis, Haliotis discushannai, Ophiura sarsii* and other species of the temperate zone, find their feeding and breeding grounds in these seas.

The East China Sea and the northern section of South China Sea, including Guangdong, Guangxi and the northwest of Taiwan, are part of the subtropical marine ecosystem. Coral reef and mangrove ecosystems are developed in this region. In addition, at the mouths of the Yangtze and Pearl Rivers, estuarian ecosystems are formed. The recorded number of mangrove subspecies accounts for more than 40 percent of the world's total.

The vast seawaters south of Hainan and southeast of Taiwan constitute the tropical marine ecosystems, with high richness in marine species. This ecosystem is characterized by well-developed coral reefs. Some 185 *Zooxanthellate* corals are recorded in these areas, accounting for 22–25 percent of coral species in the Western Indian Oceanic region.

Species Diversity

Species are the basic units that make up the biosphere. They are constantly changing and developing, but at the same time are relatively constant as well. The composition of species, the relationships among them, and changes in the complicated relationship network between them and abiotic environments often determine the prosperity or decline of a given ecosystem. Therefore, the richness of species diversity reflects, to a large extent, the current status of all ecosystems under question and the trend of human impacts.

Biogeographically, China is situated in both the Palaearctic and Oriental Realms. During the late Tertiary, most regions were not affected by

glaciation, thus the flora and fauna are characterized by having many endemic and relic species. China is therefore regarded internationally as one of the megadiversity countries in the world, having about one-tenth of the total number of species in the world.

A great number of surveys on animals, higher plants and cryptogam carried out mainly after 1949, revealed sizeable gaps in the inventories of different biotic taxa. Much remains to be discovered about them. Over the years, new taxa and records have been published; and according to 1980–86 statistics, the number of new species of insects and angiosperms have increased by 500 each. The described invertebrates and cryptogams are only a very small fraction of existing species. New species are still being discovered in China. Even representative species of new orders are just now being recognized, such as *Zorotypus medoensis* and *Zorotypus sinensis*.

Even for the comparatively better-described taxa of plants (such as mosses, ferns, gymnosperms and angiosperms) and animals (such as mammals, birds, reptiles, amphibians and fish), new species or new records for the described species are also being recognized—for example, *Thermophis baileyi* among reptiles, *Ranodon sibiricus* among amphibians, and *Nipponia nippon* among birds. The latter had been considered extinct for many years.

According to the new statistics, the total number of all existing species in China amount to about 83,000 species, including marine organisms but excluding soil organisms, microorganisms and insects (see Table 1.1). It is roughly estimated that more than 100,000 species of insects are distributed throughout China. There are more than 13,000 marine species recorded for China's seawaters (as shown in Annex 2).

During the several thousands of years that agriculture and animal husbandry have been practiced in China, a great number of species of high quality grain crops, fruit trees, industrial crops, poultry and livestock have been developed, domesticated and bred; and tens of thousands of their varieties raised. China is one of the main origins of the world's crops. According to a rough estimate, China has 237 varieties of native domestic plants, and 200 varieties of native poultry and livestock. At present, domestic plants are recorded at more than 600 species and over 100,000 varieties or cultivars.

Genetic Diversity

Genetic diversity refers to the variety of genes that are present within individuals, both within a single species and between species. Relatively high genetic diversity within a species can be found, for example, in the wild relatives of the potato that grow in South America. Low genetic diversity occurs in a field of corn made up of a single hybrid, selected over the years for highly specialized characteristics.

Genetic diversity or gene diversity is an important part of biodiversity. Species are the basic units in taxonomy and are the basic links in the evolutionary chain of organisms. A species is made up of many populations that demonstrate very rich genetic variations and make possible a large number of different genetic types. China has very high richness in species and can be considered to have one of the

Table 1.1: Numbers of Species of Major Biotic Taxa in China (compared to world totals)

Taxa	Species in China (SC)	Species in world (SW)	SC/SW (%)
Fungi	8,000	46,983	17.0%
Bacteria	5,000	26,900	18.6
Algae	500	3,060	16.3
Mosses	2,200	16,600	13.3
Ferns	2.600	10,000	26.0
Gymnosperms	200	750	37.8
Angiosperms	25,000	220,000	11.4
Insects	40,000	751,000	5.3
Fish	2,804	19,056	12.1
Amphibians	279	4,184	7.0
Reptiles	376	6,300	6.0
Birds	1,186	9,040	13.1
Mammals	499	4,000	12.5

most important stocks of genetic diversity in the world.

Genetic diversity of wild plants and animals. China's great diversity of wild animals, plants and microorganisms represent a treasure house of genetic diversity. Indeed, it is the genetic diversity that underlies and provides the foundation for the nation's species diversity, and through it, the ecosystem diversity. Since such a large part of China's wild species are unique to China, it follows that their genetic diversity is of particular importance. This importance, of course, extends from the possible direct benefits to man from unique animal and plant genetic composition, for example, for food or medicines, through its role in maintaining the species involved with their multiple inherent and economic values, to their key roles in maintaining the ecological functions and processes that are fundamental to human welfare and survival.

Genetic diversity is also very important for the identification of conservation priorities. According to Zhang Yaping and Shi Liming's research (1991) using 20 mitochondrian DNA restriction enzymes, rhesus monkeys in China can be divided into three different groups and the North China group has very special features that should be taken into account in their conservation. Once a species is reduced to a remnant of its former abundance, much of its genetic diversity has been lost and its ability to benefit people is greatly decreased. Because the likelihood of species persistence increases with its genetic diversity, a small or isolated remnant of a species can be much more vulnerable to extinction than a very genetically diverse population. By the time a species is recognized as endangered, it may have lost so much genetic diversity that its chances of survival may be slight and it may be too late to save that species. Thus, biological diversity is a particularly fragile resource.

Genetic diversity of domestic plants. The genetic diversity of domestic plants is an important part of genetic diversity as a whole. It includes all of the variations of different kinds of economic or resource plants, such as grain crops, cash crops, fruit trees, vegetables, forage grasses, flowers, turf plants, medicinal plants, and forest trees, that are closely related to human living and that have been the base for agriculture and forestry throughout time.

As a result of natural and artificial selection over China's long agricultural history, a large number of crop varieties and types emerged and came into being to adapt to different natural conditions, growing patterns and utilization needs. They demonstrate an extremely high richness in genetic diversity: more than 600 crop species and about 237 that originated and differentiated here. For these reasons, China is considered one of the major crop origin centers in the world.

All main crop species have a large number of cultivars or strains, and most of them have wild forms or relatives that are specific to China and widely distributed all over the country. China is one of the places of origin for rice (*Oryza sativa*). There are about 50,000 cultivars or strains of rice and 3 wild rice species as well, namely, *Oryza rufipogon, Oryza officinalis*, and *Oryza meyeriana*. Wheat is cultivated almost all over China and has about 30,000 cultivars or strains. Soybean, *Glycine max*, which has about 20,000 cultivars or strains, originated and is widely distributed in China. In addition, wild soybean (*Glycine soja*) is widely distributed in China. The situation mentioned above is unique in the whole world.

There are about 80 common vegetable species in China and 20,000 or so cultivars or strains, most of which are specific to China. There are about 30 species and 10,000 cultivars of commonly cultivated fruit trees. Among them, *Citrus* (spp.), *Nephelium litchi, Nephelium tonganumcam*, and *Erioboty japonica* originated in China. Besides these, there are 52 species, varieties or forms of the new fruit trees *Actinidia* (spp.) in China, but only 54 of those in the whole world.

China has very rich resources of forest tree species, with about 8,000 species of woody plants. Many of these are endemic to China.

There are considerable genetic variations among different domestic plants not only in mature phase and adaptability, but also in disease and stress resistance, style, texture, and chemical composition of products—and even for the mating behavior of distant hybridization and characteristics of *in-vitro* culture of tissues and organs.

Genetic diversity of domestic livestock and poultry. Because of its long history of animal husbandry and diversified geographical conditions, China has many species and strains of domesticated animals and birds. According to 1989 statistics, China has 590 varieties of domesticated animals and poultry, among which there are 66 for horse, 20 for ass, 73 for ox and cow, 20 for water buffalo, 50 for yak, 4 for camel, 79 for sheep, 43 for goat, 113 for pig, 109 for chicken, 35 for duck, 21 for goose, and 3 for turkey. All these fine varieties constitute very valuable gene pools.

Many local varieties have fine production features. Some have high reproduction characteristics. For example, the small-tailed cold sheep in the Heze area of Shandong Province has the reproductive rate of more than 270 percent in a single lambing. A mature Taihu sow gives birth to more than 15 baby pigs at one farrow on average. The Jinding duck in Fujian Province and the Shaoxing duck in Zhejiang Province lay 260 to 300 eggs a year on average, and a single egg weighs more than 60 grams.

Other strains are noted for their products with excellent quality. For example, the hide from Ningxia Sands sheep, the skin from Taihu Lake goats, the wool from the Albas wool goats, the bristles from Rongchang pig in Sichuan Province, and others are all famous for their excellent quality.

There are some strains that have particular characteristics. For example, the Baise small horse in Guangxi Zhuang Autonomous Region is only 1 meter high at maturity. The sweet pig in Guizhou Province and the Wuzhishan mountain pig in Hainan Province have the body weight of only 40 kilograms or so at maturity. China's rich species and varieties of domesticated animals are precious genetic resources.

The pig is one of the important domestic animals. Some good genetic qualities of Chinese pigs, such as fast growth, high reproduction rate, and adaptability to coarse fodder, have significant influence on pig breeding in many countries in the world. Similarly, biochemical and genetic studies on 20 of the main ox varieties in China have provided valuable information and data on their origin and on the relationships between their different varieties that may prove useful to their breeding elsewhere.

It is worth mentioning that the south western region of China has a large number of special local breeds and forms of domesticated animals and should receive more attention because of its unique geographical location. The varied climatic conditions and geographic isolation, and the unique economic and cultural conditions of its many minority nations make it an important region for studies on the genetic diversity of Chinese domesticated animals and for developing genetic resources of animals. Some wild relatives of the ox feed and breed have been found in this region. Among them, the *Bos grunniens, Bos gaurus, Bos javanicus* and *Bos indicus. Bos frontalis* in the Dulong River basin in the northwestern region of Yunnan Province deserves close attention. *Bos frontalis* feed and breed in forests and bushes on steep slopes. They have a large body, tender meat, excellent adaptability to rough natural environments, and quite tame character, providing valuable genetic resources for further development.

Genetic diversity of fish. There are about 24 species of the main freshwater fish bred in China, of which the "four domestic fish" (that is, the black carp, grass carp, silver carp and bighead carp) have the widest distribution. Other bred aquatic animals not so popular as the four domestic fish are river crab, shrimp, turtle, soft-shelled turtle, and red worm.

Seawater breeding has been developed in the past 30 years. The bred species include *Penaeus orientalis, Mytilus edulis, Haliotis discus hannai, Epinephelus akaara, Pagrosomus major, Sparus*

latus, Lates calcarifer, Ostrea (spp.), Laminaria japonica, and *Eucheuma* (spp.).

Although freshwater breeding originated in ancient times, the traditional breeding method was limited in that all fry were caught from natural waters and then kept and bred in fish ponds. Even the four domestic fish were not artificially bred until 1958. However, the construction of a number of big water conservancy projects destroyed most natural breeding sites, and now most fish fry used in fish farms carry out their life cycle under artificial control. After over 10 generations of inbreeding, the germplasm resources have been seriously degraded, evidenced by smaller fish size and a tendency toward maturing early.

Special Features of Biodiversity in China

High Richness of Biodiversity

China occupies an important position in the world in the variety and quantity of biological resources. For flora, China has 30,000 species, ranking third in the world after only Malaysia (about 45,000 species) and Brazil (about 40,000 species). It has 106 families of mosses, accounting for 70 percent of the world's total; 52 families and 2,600 species of fern, making up 80 percent and 26 percent respectively of the world's totals; 8,000 species of ligneous plants, of which there are 2,000 species of trees. Of the 12 families, 71 genera and nearly 750 species of gymnosperm in the world, China boasts 11 families, 34 genera and 240 species. The total number of conifers in China accounts for 37.8 percent of the world's total, and angiosperms make up 54 percent of the families and 24 percent of the genera respectively of the world's totals. Besides these, many ancient species peculiar to China also occupy an important position in the world.

China has one of the richest resources of wild animals in the world, with many rare and endemic species. Statistics show China has 2,340 species of terrestrial vertebrate animals, accounting for 10 percent of the world's total. China also is one of the countries with the most species of birds, accounting for 13 percent of the world's total. Of the 166 species of wild ducks in the world, China has 46 species, or 28 percent. Of the 15 species of cranes, China has 8 species, more than half of the world's total. And there are 499 species of mammals in China, accounting for 11 percent of the world's total. China has 16 species of primates, more than those found in some European and American countries. This shows the important world position of China's wild animals. Among about 40 marine divisions in the world, China's seas have almost all of the representative species and hold a high species percentage.

Agriculture has a long development history in China, whose cultivated crops, fruit trees and cash crops all occupy important positions in the world. China is one of eight original centers of crops in the world. Of the 1,200 species of cultivated crops in the world, about 200 originated in China, accounting for 18 percent of the world's total. China has many varieties of the important grain crop, rice, which ranks second in the world in its sown area.

High Endemism of China's Biodiversity

The vast territory, varied climatic zones, and diversified geomorphic conditions contribute to complex and diversified ecological environs in China. The limited distribution of glaciers during the Tertiary Period left many species untouched, contributing to the large numbers of endemic species and relic species in China. The "living fossil" animals and plants, such as *Ailuropoda melanoleuca, Lopotes vexillifer, Metasequoia glyptostroboides*, and *Cathaya argyrophylla*, illustrate the endemic species, endemic genera and even endemic families in China. Table 1.2 presents a statistical summary of the endemic species and endemic genera.

The endemic species in China are distributed in specific biotopes with limited spacial and areal coverage. For example, *Ailuropoda melanoleuca* feeds and breeds in the forests with *Simarundinaria* (spp.) at elevations of more than 2,300 meters, growing in the Qingling mountain ridge on borders between Sichuan, Gansu and Shanxi Provinces, in the east-

Table 1.2: Number of Endemic Genera and Species in China

Taxa	Known genera or species in China	Endemic genera or species in China	Endemic as percentage of known Chinese genera or species
Bryophytes	494 gen.	8 gen.	1.6%
Pteridophytes	224 gen.	5 gen.	2.2
Gymnosperms	34 gen.	8 gen.	2.5
Angiosperms	3,116 gen.	232 gen.	7.4
Fish	2,804 spp.	440 spp.	15.5
Amphibians	279 spp.	30 spp.	10.8
Reptiles	376 spp.	26 spp.	6.9
Birds	1,186 spp.	99 spp.	8.0
Mammals	499 spp.	72 spp.	14.8

ern section of the Mingshan mountains and in the Gongga mountains, while *Metasequoia glyptostroboides* grows along the banks of the Modaoxi River. Studies of these specific phenomena are needed to determine the requirements of flora and fauna in different regions, in order to guide conserving biological diversity, and to determine priority areas for protection of biological resources.

Special Features of Evolution of Biota in China

The high richness of biodiversity in China resulted from its diversified physiogeographical environment and species evolution. Millions of years ago continents were connected together to form megoplates. In time, the megoplates split down into smaller plates that shifted away from each other. The contemporary Indian subcontinent or Indian plate separated from the African continent, and shifted and crashed into the Asian plate. Under the colliding and crashing of the Indian plate, the earth crust in Middle Asia uplifted, emerged from seawater, and connected with Xinjiang. The collision of the Indian plate on the Asian plate resulted also in the uplift of the Himalayas.

In ancient geologic time the Chinese continent was connected to the North American continent. Many plant species in China bear similarity with those in North America. One of the important factors making the flora and fauna ancient and rich is that the Quaternary glaciation left most of China uncovered. When the northern part of Eurasia was frozen by ice and temperatures dropped, many species moved to the south. At that time, the mountains in the southern part of China had a humid and warm climate, which helped many species to survive. The favorable paleogeographical environment of China provided either shelter and refuge for many ancient species, or a place of origin for many new species. This is also the reason many ancient species have distinctive regional features.

Flora and fauna in China originated in ancient times, with complex elements and large numbers of ancient or prime families and genera. In its flora, China has components from the whole world's tropical and temperate zones including the ancient Mediterranean as well as those endemic to China, with their own diversified types and complex makeup. However, tropical components predominate. For instance, plants from pan-tropical zones account for 56 percent of the total 300 families in the country. The tropical and subtropical zones, and especially the subtropical mountain area in the Southwest, might be the centers where many plants evolved or developed.

The terrestrial vertebrate fauna also originated in the ancient times, within diversified zones. The Qinling Mountains and the Huaihe River can be

taken as the demarcation line between geographical regions. South of the line belongs to the Oriental Realm, and north of the line to the Palaearctic Realm. The line basically coincides with the northern border of evergreen broad-leaved forests. Some ancient species still survive in China today, and are well known and very precious species in the world.

Marine biota have undergone a long evolutionary history with varieties of species and can be divided into two geographical regions, basically along the latitudinal line of 32° North. The northern part is called the East Asian Subregion in the temperate Pacific Ocean, while the southern part includes two subregions, the Sino-Japanese Subregion in the tropical Indian-Pacific Ocean (the continental shelf seawaters) and the Indian-Malaysia Subregion in the Indian-Pacific Ocean (the continental slope and deep-sea slot areas). Some of the relic ancient species have been preserved in China's seawaters, such as the "living fossils" *Tachypleus tridentatus* and *Nautilus pompilius*.

High Richness of Economic Species

According to statistics (Ministry of Agriculture, 1992), there are more than 3,000 species of wild economic plants, including 440 species of fibrous plants, 150 species of starch plants, 260 species with high protein and amino acids, 370 species of oil plants and aromatic oil plants, 1,000 species of medicinal plants, 300 species of timber trees, and 500 plants with insecticide effects. Besides these, there are also plenty of other economic plants, such as resin and gum plants, rubber plants, and tan plants.

China is also rich in animal resources. There are 330 species of economic birds in China and 190 species of economic mammals. There are about 60 species of important economic fish in China. In addition, there are a great variety of economic microorganisms in China as well; for example, 700 species of wild edible fungi, 380 species of medicinal fungi, and 300 species of mycorrhiza. Wild animals can be used for meat, fur, medicine, and ornament, so many of them have been bred and domesticated, such as snake, tortoise, soft-shelled turtle, deer, musk, bear, muskrat, marten, fan shell, mussel, prawn, grouper, red porgy, *Sparus tatus*, *Lates calcarifer*, and eel.

Threatened Status of China's Biodiversity and Causes

Overview of Threatened Status

Threatened status of ecosystems. Continued destruction and deterioration of ecosystems has now become one of the most serious environmental problems in China. Destruction of ecosystems is mainly shown in reduction of forests, degradation of grassland, desertification of land, soil erosion, decrease of farmland, deterioration of water quality along coastal zones, frequent occurrence of red tide, decrease of economic resources, and intensification of natural disasters.

Forests are the ecosystem type most widely distributed in terrestrial areas and with the greatest biomass and biodiversity. For a long time China's forest resources have suffered damage from random felling, destruction of forest for farming, forest fires, and plant diseases and pests. This has resulted in drastic loss of forest area, especially natural forests. The area of natural forest in China was 98.17 million hectares in 1971–75, while in 1981–85, it decreased to 86.35 million hectares. The coverage of natural forest in Hainan Province was 25.7 percent in 1956, and by 1964 was down to 18.1 percent. By 1983, only 7.2 percent was left. As the most important forest area, Heilongjiang primary forest area originally had 23.16 million hectares of natural forests, but in 1985, only 12.38 million hectares remained.

Steppes account for about one-third of China's total area. During the past 20 years, yields of grass have decreased by one-third to one-half. For grasslands in the semi-arid areas in the north, output is low, and degradation caused by over-grazing, destruction of grassland for farming, and plagues of rodents is extremely serious. All grassland ecosystems face serious decline. Threatened by grassland deterioration and intensified by wind-blown sand, desertifi-

cation in the north has already accelerated and the area of desert is expanding. For example, the desertified area in the Erdos plateau in the 1950s was only 200,000 hectares, but by the beginning of the 1980s, it was up to 600,000 hectares. At the same time, over 400,000 hectares of grasslands suffer from serious soil and water loss.

The aquatic ecosystems in China have been severely damaged as well. In the past 3 decades, over 7 million hectares of wetland were reclaimed. This together with the land formation form natural siltation and artificially reclaimed land from the sea has caused far-reaching negative influences on the marine biotic resources in the waters near the reclaimed areas. In the early 1950s, there were 50,000 hectares of mangroves in the coast of South China Sea, but at present the area is reduced to 20,000 hectares, due to reclamation and felling. Even the remnants have been degraded and have become semi-mangrove and secondary sparse woodlands.

The freshwater ecosystems have been destroyed badly as a result of such activities as construction of water conservancy and power stations and reclaiming land from lakes and rivers. For example, a large area of wetland in the Yangtze River basin has been turned into farmland. According to statistics, the reclaimed lands from rivers amount to 1.7 million hectares in Hubei, Hunan, Jiangxi and Anhui Provinces alone. As "the province with a thousand lakes" in the past, Hubei Province has only 326 lakes and rivers left now and the water area is reduced from 1.25 million hectares, to 0.355 million hectares. This results in a decrease not only in wetland and aquatic habitats, but also in their ability to regulate floods. In addition, this blocks the migration passageways for some important economic fish.

The coral reef resources in China are mainly distributed along the coastline of Hainan island. About one-fourth of the 16,000-kilometer coastline is occupied with coral reef where marine bioresources are quite abundant. In recent years, due to lime mining and handcraft-making by the local residents, 80 percent of the coral reefs along the coast of Hainan island have been damaged, and the reefs in some sections are on the verge of extinction.

Threatened status of species and genetic diversity. Although China has a high richness in species diversity, the fast growth of its population and the high speed of economic development in the recent years has increased its demands on the natural ecological environment and species of living organisms, putting a tremendous pressure on them and making many plant and animal species severely endangered. Scientific surveys on China's biotic and natural resources have accumulated valuable statistics. A rough estimate shows that about 398 vertebrate species in China are endangered, or 7.7 percent of the total vertebrates (as shown in Table 1.3)

It is estimated that 10 percent of the plant species are endangered or vulnerable in temperate zones, and a much higher percentage in tropical and subtropical zones. Owing to heavy deforestation, the estimated proportion of endangered or vulnerable plant species in China as a whole is about 15–20 percent, or about 4,000–5,000 species of higher plants.

Based on historical records of the extinction of plants and animals in China, several animal species, such as *Rhinoceros* (sp.), *Elaphurus davidianus, Saiga tatarica, Panthera tigris lecoqi*, and *Pygathrix nemaeus*, as well as plant species, such as *Thuja sitchuanensis, Ombrocharis dulcis*, and *Machilus minutiliba*, have been extinct for decades or even centuries. It is believed that the *Saiga tatarica* died out in Xinjiang in the early 1960s.

Animal species threatened to the brink of extinction are: *Nipponia nippon, Panthera tigris allaica* and *P.t. amoyensis, Neofelis nebulosa brachyurus, Ailuropoda melanoleuca, Presbytis* (spp.), *Hylobates* (spp.), *Dugong dugong, Cervus eldi, Lipotes vexillifer, Archineottia gaudissartii, Diplandrorchis sinics, Cycas hainanensis, Cephalotaxus manni, Panax zingiberensis, P.ginseng, Gastrodia elata, Cistanche deserticola, Boschniakia rossica*, and *Paeonia suffruticosa* var. *papaveracea*. Among these species, the crested ibis

Table 1.3: Estimated Number of Endangered Species in China

Taxa	Number of species	Number of endangered species	Endangered species as percentage of total species
Vertebrates			
Mammals	499	94	18.8%
Birds	1186	183	15.4
Reptiles	376	17	4.5
Amphibians	279	7	2.5
Fish	2804	97	3.5
Subtotal	5144	398	7.7
Higher Plants			
Bryophytes	2200	28	1.3
Pteridophytes	2600	80	3.1
Gymnosperms	200	75	37.5
Angiosperms	25,000	826	3.3
Subtotal	30,000	1009	3.4
TOTAL	35,144	1431	4.1

(*Nipponia nippon*) reportedly was still abundant in a rather wide range in the 1950s, but only a small population was found in the late 1970s.

A great deal of aquatic organisms of all kinds are being threatened or endangered. Some species with big economic value and sensitive species in many lakes and rivers are being gradually reduced, and even sometimes to extinction. For example, the "three sturgeons" (*Sripenser schrencki, A. sinensis* and *A. dabry-anus*), river dolphin (*Neomeris phocae-noides*), and the white flag dolphin (*Lipotes vexillifer*), and some economic fish in the Yangtze River, such as hilsa herring (*Macrara reevesii*), madarin fish (*Sinicarpa chautsi)*, and whitebit (*Salanx cuvieri*), have become rare and endangered. The catch yield of the main economic fish like the prawn, crab, hairtai, and yellow croakers has dropped progressively.

In addition to the losses of species themselves, there is a great threat of loss of genetic diversity within the species. As habitats become fragmented and the total numbers of individuals within a species reduced, the genetic base becomes increasingly narrow. There is less and less opportunity to avoid inbreeding and to maintain genetic diversity. This narrow genetic base affects both animals and plants. In the case of domestic species. the problem is aggravated by intentional selective breeding for a narrow set of desired characteristics.

The domestic plants in China are also in a seriously threatened state. Due to the high speed of economic development and its unrestricted progress in coastal areas, the agricultural regions are suffering from severe environmental damage. Many old valuable varieties are becoming nearly extinct because of the introduction of so-called "high quality varieties." For instance, in 1964, 2 species of wild rice were found at 24 sites in Jinghong County, Yunnan Province, but at present they can be found in only 1 site because of land reclamation and the growing of rubber trees. Wild soybeans could be found nearly all over the Yellow River delta and Sanjiang Plain in the past, but now they are scattered in fewer sites in these areas; in the suburb of Shanghai, there were 318 varieties of vegetables in 1959, but there were only 178 varieties left in 1991.

In summary, if the valuable genetic resources of both wild and domestic plants in China are not saved efficiently right now, they will soon be lost; and the current status of animal genetic resources is also very serious. Clearly, the consequences of losing genetic resources such as these are staggering and probably incalculable.

Causes of Threats to Biodiversity in China

Destruction of habitat. While China has been successful in controlling population growth relative to many other developing nations, its vast existing population means that the absolute annual increase in population numbers is enormous. This constant pressure combined with accelerated eco-

nomic development is putting immense stress and demand on natural resources.

Another important consideration is that the distribution of population is not even in China (as shown in Annex 4). The population is highly concentrated in the southeastern part of the country, while the northwestern part is quite sparsely populated. In the six northwestern provinces (Inner Mongolia, Ningxia, Xinjiang, Xizang, Gansu and Qinqhai), the population density is 14 people per square kilometer, while in the other provinces the density is 142 people per square kilometer (according to 1990 government statistics). Therefore, the impacts of the human population on China's biodiversity are enormous.

Excessive felling of forests, conversion of grasslands, lakes and other wetlands, over-grazing by domestic livestock, over-exploitation of water and land resources, all lead to severe damage and destruction of habitats, threatening the existence of many species. Additional pressure comes from construction activities such as expanding urbanization and industrialization, construction of dams and reservoirs, building of roads and other transportation facilities, and the vast expansions of agricultural activities.

As a result many species have disappeared already. Many rare and endemic plant species have died out, such as *Ormosia hovii, Hopea mollissima, Nyssa yunnanesis* and *Carallia diplopelela*, or are surviving with very limited populations, such as *Ostrya rehderiana, Abeis beshanzuensis, Apterosperma oblata*. The coral reef in the South China Sea has been harvested excessively, and the coral reef fish have died out as their habitat disappeared. According to a rough estimate, the endangering of 4,000 to 5,000 plant species will result in threat to 40,000 species of living organisms, which even if only partly accurate, issues a stark warning to the world.

Additionally, some huge water conservancies caused lakes and river blockage, destroying habitats for aquatic organisms and causing a great deal of them to be endangered. The Yangtze River reach between Gezhouba dam and Nanjinguan is the spawning place for the "four domestic fish." After the dam was completed, the current velocity, water temperature and other hydrologic conditions changed, and spawning places were destroyed. According to statistics, the fry quantity of the "four domestic fish" in the middle reach of the Yangtze River is starting to decline. The number of fry in 1980 was 15.7 percent of that in 1961, and the number in 1981 was 59.0 percent of that in 1980. The dam blocks the way of sturgeon swimming up the Yangtze to the Jinsha River for spawning; and many stay below the dam and many others are killed in the attempt to bypass the dam.

Because they are very small, microorganisms are sensitive to changes in their environment. So, the destruction caused by human activities may make many microorganisms extinct before they are even described.

Over-exploitation of biodiversity. Over-exploitation of living resources is a major cause of loss of biodiversity in China. The needs and demands of an ever-increasing human population exert an intense and constantly increasing pressure on all biodiversity. Plants are cut for fuel, building materials, food and medicine. Birds, mammals, reptiles, fish and many invertebrates are hunted and fished virtually everywhere they are available. While subsistence food needs are a major source of the demand, there is also an important economic drive. Many animals have economic value for their skins, hides and horns; as medicines; for export; and for food. Certain restaurants (for example, in Guangdong Province) are famous for serving meat of endangered species—at very high prices. It is estimated that virtually all forms of fish and terrestrial wildlife that are accessible are declining, some precipitously, due to over-harvesting.

Over-harvesting and over-hunting cause direct threats to many species. In the 1950s, the macaque was captured in large numbers and much of its habitat was lost, and the population declined on a large scale and has not yet recovered. Animal resources such as the gazelle, deer and other fur-bear-

ing animals, as well as freshwater fish, have also declined because of over-harvesting.

Pollution. The large amount of industrial and agricultural polluted water (from both urban and rural areas) discharged to rivers and lakes, air pollutants (especially acid rain), heavy metals, and long-lasting pesticide residues in the environment have endangered many organisms in both aquatic and terrestrial ecosystems. According to statistics, agricultural land polluted by industrial wastes is about 15 million hectares, or about 10 percent of the total farmland across China. Another 15 million hectares have been polluted to some extent by agricultural chemicals. The total economic loss from these two items is about 15 billion yuan each year.

The freshwater in China also is seriously polluted by industrial wastewater, causing major declines in aquatic flora and fauna. Serious pollution occurs in the sea and near the seashore from oil spills. Some aquatic biota in the Yangtze and Songhua Rivers are endangered or even on the brink of extinction, such as the grass carp, silver carp, variegated carp, curcian carp, catfish, pike, black carp and triangular bream. Pollution is also the main factor causing the decline of species in marine areas, especially along the coast.

Air pollution is also an increasingly serious threat to biodiversity. Most of the problem comes from China's increasing industrial sector and from vehicles. The damage is most clearly seen on vegetation; but as in other parts of the world, acid rain from (often distant) industrial areas can have significant effects, weakening and killing forests and damaging aquatic life from the increasing acidification of lakes and rivers.

Other factors. There are, of course, many other contributors to biodiversity loss in China. To a large degree the various threats work together to multiply each other's impact on biological resources. For example, the over-exploitation described above combines with habitat loss to greatly increase the threat to biodiversity. As the suitable habitats become reduced and fragmented into smaller patches, the wildlife in them become more and more vulnerable to hunting. In the same way, species that are restricted to isolated or fragmented patches of suitable habitat become much more vulnerable to the fires, storms, floods, droughts, exotic species, diseases, pests and parasites that would not pose such threat within adequate habitat.

A further related threat is the breakdown of ecological functions, which is a step beyond simple habitat destruction. Where water catchment areas have been denuded, the watershed function of the forests is lost, and the result often is soil erosion and floods that have devastating effects both on humans and on biodiversity. Filling in of wetlands has a similar effect, destroying the water recharge of the subsurface waters and leading to droughts in the dry seasons and floods in the wet. The destruction of reefs, coastal wetlands, mangrove forests and other forms of destruction of the coastal habitats leads to collapse of the functioning marine or coastal ecosystems. In all these cases, what is involved is loss of the ecological functions on which life, both wild and human, depend.

A threat of another kind—and particularly important to biodiversity—comes from the failure of the supporting measures that are essential for any country to carry out effective biodiversity conservation. These supporting measures are analyzed in greater detail in the next chapter and are only mentioned here as other factors that put the nation's biodiversity at risk. They include the nation's policies, laws and their enforcement (or lack of enforcement), along with the institutional problems from having a multitude of different administrative organizations with responsibilities and authorities affecting conservation. Lack of coordination and cooperation between the various governmental entities involved is a major obstacle to effective conservation. Associated with this is lack of awareness both by government personnel and the general public, about the importance and urgency of biodiversity conservation.

Urgency of Biodiversity Conservation and Demand for Sustainable Utilization

Urgency of Biodiversity Conservation

As described in the sections above, the destructive utilization of biological resources has already caused the extinction of many species and endangered many others, and has generally affected biodiversity adversely throughout China. According to statistics, China lost thousands of species in the last half century. For example, the only remaining prime horse in the world, *Equus przewalskii*, disappeared in the early 1950s. *Saiga tatarica* and *Elaphurus davidianus* met the same misfortune in the 1960s.

Some species that have been lost are part of everyday language and life. For example, some rare and endemic species of wild animals gave their name to localities near their feeding and breeding grounds, such as Wild Yak Gully, Wild Horse Sands, Town of Moose, Town of Gazelle, and others. Because of the extinction of these wild species, however, Wild Yak Gully now has no wild yaks; Wild Horse Sands, no wild horses; and their namesake towns are left with no moose or gazelles.

In addition to these species, there are some hundreds more facing the same fate. For example, more than 400 endangered wild vertebrates are listed in China's Wild Animal Conservation List, and 1,019 endangered plants are listed in China's Red Data Book.

In addition to the species whose need for conservation is recognized in the above docu-ments, there are many others in very endangered status. The wild ducks other than those in the conservation lists are an example in the bird category. There are only a few more than 10 wild duck species surviving, while many other wild species may dis-appear and become extinct before they are even catalogued.

At present, the Chinese Government has promulgated a series of laws and regulations on environment protection and biodiversity conservation. They include laws on forestry, grasslands, wild animal protection, environmental protection, and the seawaters. Many natural reserves have also been established. These efforts are yielding some important results. But considered as a whole, the biota and species in the country are still under severe threat and are still being damaged and destroyed. It is estimated by some Chinese biologists that the whole community of all living organisms in China is being affected at a speed and cost of the loss of one species per day. This critical situation makes safeguarding and rescuing biological diversity and diversified ecological systems in China a necessity of extreme urgency.

Demand for Sustainable Use of Biological Resources

China has one of the largest populations and fastest growing economies in the world. As described earlier, this large population and fast-developing economy have put demands on biological resources, on both varieties and quantities, that are increasing with time.

Industrial and agricultural development, as well as improving living condition in both urban and rural areas, has increased the country's demands on timber drastically, leading to overfelling of forests. The reduction in forest areas has deprived many animals, plants and microorganisms of the habitats on which they relied for their survival.

Faced by the fast-growing population and economy and their increased demands for agricultural, animal husbandry and fishery products, agriculture has expanded the cultivated areas in attmpts to boost grain, cotton, sugar, tea, fruit and vegetable oil production to meet the needs of the society. But this progress, too, was at the cost of forest, grassland and wetland destruction. Trying to further increase its production, agriculture has increased the use chemical fertilizers and pesticides, the practice of year-round cultivation, and the dissemination of high-yielding crops and varieties. In addition, animal husbandry and fisheries have exceeded the carrying capacities and have resorted to over-harvesting.

Over-exploitation of natural resources has resulted in their devastation. Farmlands have lost fertility, grasslands have deteriorated, and deserts have increased at an average annual rate of 1.8

million hectares. A large amount of good prime germplasm of crops and species have been lost. Over-fishing has led not only to reduced numbers caught but also to smaller sizes of the individual catch. The annual yield of some species such as *Trichiurus haumeia* has diminished drastically, and the size of the caught individuals is less than one-third that in the past.

Although the above facts are well known to all of society, they have not received enough attention or effective action. Emphasis is still being put on economic development and intensive utilization of biological resources. Conservation and protection of renewable biological resources is still being neglected. If these trends continue, the biological resources now available for China's development will simply not be available in the future. Therefore, if for no other reason than to ensure a supply of needed resources for the future, it is necessary now to adopt strict measures to stop their destructive exploitation and to enhance their protection, and to learn how to use them rationally and efficiently.

Chapter 2
PRESENT STATUS OF BIODIVERSITY CONSERVATION IN CHINA

Description and Assessment of In-situ Conservation Efforts

In-situ conservation is the most effective measure for conserving biodiversity. In-situ conservation means protecting valuable natural ecosystems and habitats for wildlife that can protect the reproduction and evolution of life in ecosystems and keep the energy flow, material cycling and ecological process in the system. Nature reserves and national parks of different types are one key way to accomplish this objective but efforts must also be made to provide protection outside formal protected areas as well.

China's first nature reserve was set up in 1956 at Dinghushan in Guangdong Province. At first, the rate of establishment of nature reserves was slow, but it has recently accelerated, so that there are now over 700 nature reserves in the country covering 5.54 percent of the total area (see Table 2.1 and map in Annex 4). There are also over 480 scenic areas and over 510 forest parks, many of which play an important role in the conservation of biodiversity. Table 2.2 classifies nature reserves according to their dominant ecosystem type and shows the number, area and coverage percentage in each group. This analysis uses a very coarse classification of ecosystems and does not allow for more than one type of ecosystem per reserve but is useful as an interim measure pending completion of a detailed protected area system review (as recommended later on). The total area of nature reserves, forest parks, and scenic areas now exceeds 65 million hectares, but many nature reserves include villages, farms, grazing land, and plantations, and the degree of past and present human impact varies widely between reserves. Many nature reserves are small (Table 2.3) and are surrounded by large areas of degraded ecosystems.

There is no single authority managing nature reserves; Table 2.4 classifies nature reserves according to who they are managed by and at what level (national, provincial, or county). Most of the nature reserves are operated by the forestry sector, and all the scenic areas are operated by the Ministry of Urban Construction. Some of the nature reserves have received international recognition; that is, there are nine Man and the Biosphere Reserves, five World Heritage Sites, and six reserves under China's commitments under the Ramsar (wetland) Convention.

The nature reserves in China can be classified for the protection objective into three categories and nine types. The three categories are: nature reserves of ecosystems, nature reserves of wildlife or species, and nature reserves of relic remains or of cultural heritage sites. Although ecosystem reserves

Table 2.1: Development of China's Nature Reserves (1956–91)

Year	Number	Area (hectares)	Percentage of total territory
1956	1	1,133	
1965	19	648,874	0.07
1978	34	1,265,000	0.13
1982	119	4,081,935	0.40
1985	333	19,330,000	2.10
1987	481	23,700,000	2.47
1989	573	27,063,017	2.82
1991	708	56,066,650	5.54

Source: Complied from statistics provided by relevant ministries (1993).