

## BIODIVERSITY AND CONSERVATION IN CHINA: A VIEW FROM ENTOMOLOGISTS

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**Abstract** China is among the twelve megadiversity countries in the world and one of the two countries with the highest biodiversity and endemism in Asia and South-Pacific region. China has the highest mountain system of the world and different types of environments inhabited by living organisms, ranging from the Palaearctic to Oriental Realms. These characteristics account for the magnificent species diversity and high level of endemism. Insects of 45 000 species have been recorded in China by now. The total endemic elements are obviously much more than the neighbouring countries. Especially in the south-west mountainous region and tropical areas the endemic elements occupy high proportions. The human disturbances, original habitat losses due to reclamation, deforestation, pollution, etc., are driving undetermined number of species to be endangered or extinct. Recommendations of China's insect conservation are hereon presented; identifying conservation priorities, investigating the biology and ecology of endangered species, monitoring habitat and diversity losses, compiling the "Red List" and the database of rare and endangered species, establishing reserves for insect conservation, and developing techniques of insect farming and ranching.

**Key words** Biodiversity, conservation, insect diversity, China

### 1 INTRODUCTION

China is situated in the south-east part of Eurasian continent with an area of 9.6 million square kilometers. Its topography is characterized by being higher in the west and lower in the east (Zhang 1990), roughly forming three terraces: the west terrace of the highest Qinghai-Tibet plateau, well known as "the roof ridge of the world"; the middle terrace formed by high mountains and plateaus (the total area of both west and middle terraces constitutes about 50% of the whole land area of China); and the vast eastern coastal area, mainly plains and low hills, forming the third terrace. From north to south five climatic zones are discernible: arctic temperate zone, temperate zone, warm temperate zone, sub-tropical zone and tropical zone; roughly the east and south being humid, the north and west dry, between them the semi-dry transition area. The vegetation can be divided from north to south: coniferous forest, coniferous and deciduous broad-leaved mixed forest, deciduous broad-leaved forest, ever green broad-leaved forest and tropical rain forest. Forest coverage is about 13%. Most areas of the north-west region are cov-

ered by meadow and steppe. The fauna of China ranges over both the Palaearctic and Oriental Realms. Such complex topography and climate result in the magnificent biodiversity in China. China is one of the twelve megadiversity countries in the world and one of the two countries with the highest biodiversity and endemism in Asia and South-Pacific region (Braatz 1992).

## 2 MEGADIVERSITY

### 2.1 Species diversity

**Table 1** Comparison of the numbers of described species in China and the World (cf. Biodiversity Committee of the Chinese Academy of Sciences, 1992)

Taxa	Species number of China (SC)	Species number of the World (SW)	SC/SW %
Mammals	499	4 000	12.5
Birds	1 186	9 040	13.1
Reptiles	376	6 300	6.0
Amphibians	279	4 184	7.0
Fishes	2 804	19 056	12.1
Insects	45 000	751 000	6.0
Bryophytes	2 200	16 600	13.3
Pteridophytes	2 600	10 000	26.0
Gymnosperms	200	520	37.8
Angiosperms	25 000	220 000	11.4
Fungi	8 000	46 983	17.0
Bacteria	500	3 060	16.3
Algae	5 000	26 900	18.6

Like in some other countries, in China there are still much more species to be found and identified; roughly the species from China may account for over 1/10 of the world total. For various taxa there exist quite big differences in the proportion SC/SW% due to the differences in actual number, and the history and depth in the studies on each taxon. From Table 1, we can see that SC/SW% for Pteridophytes and Gymnosperms are high-

est, 26.0% and 37.8% respectively. For insects this proportion is only 6.0%. Although insects and invertebrates in China are very abundant, the study scope is narrower and the study history shorter as compared with plants and vertebrates. In total, SC/SW% should be far beyond 10%.

## 2.2 Abundance of insect species

By now 751 000 species have been described in the world, of which only 45 000 species, only about 3/50 of the world total, have been found in China (Wu 1992a). Based on the statistics of insect groups comparably well studied by Chinese scholars in recent decades (Table 2), insect species number of China should be far more beyond 1/10 of the world total, which was the commonly accepted proportion in China until now.

**Table 2** Comparison of the numbers of described species of some insect groups in China and the World by 1991

Groups	Species number of China (SC)	Species number of the world (SW)	SC/SW %
Protura	144	546	26.3
Homoptera	4 681	32 800	14.2
Aphidoidea and Adelgidae	1 000	4 000	25.0
Hemiptera Gerridae	75	450	16.6
Hemiptera Salididae	40	230	17.9
Siphonaptera	575	3 000	19.2
Coleoptera Galerucinae	630	5 000	12.6
Coleoptera Crioceridae	170	1 000	17.0
Megaloptera	70	200	35.0
Lepidoptera Lecithoceridae	178	750	23.7
Lepidoptera Saturniidae	56	100	56.0
Lepidoptera Bombycidae	28	70	40.0
Lepidoptera Drepanidae and Cyrlidiidae	220	400	55.0
Diptera Muscidae	670	4 000	17.3
Diptera Tachinidae	700	4 500	15.5

## 2.3 Insects used as resources

**2.3.1 In agriculture and forestry** In agriculture and forestry beneficial insects are mainly grouped into natural enemy insects of pests and pollinating insects. In China the natural enemy insects of rice pest insects amount to 1 303 spp. , vegetable 781 spp. , cotton 417 spp. , soybean 240 spp. , wheat 218 spp. and apple 208 spp. (Ye and Wang 1992). They play important roles in biological control of pests. In recent years, in controlling of pests, we emphasize very much on their integrated management through control effects of natural factors, and use chemical pesticides rationally for protecting natural enemy insects to ensure their functions against the pests. Except the domestic honey bee, there are about 1 000 spp. of wild bees. Of them pollinating bees *Nomia* and *Megachile* for forage herbage and *Osmia* for fruit trees have contributed much in the production practices. Several wild bees, pollinating for famous Chinese medicine herbs (such as *Gastrodia elata* and *Amomum villosum*), have special values.

**2.3.2 In manufacture and industry** China is one of the big silk producing countries in the world. The cocoon yields account for 65% of the world total; the silk exports account for 90% of the world silk trade; the silk fabric exports account for about 45% of the world total. All three are at the highest position as compared with other countries. China is also the main producing country of cocoons of *Antheraea pernyi*, the annual yield of which is between 50-70 thousand tons (Meng 1992). The silk of eri silkworm *Philisamia cynthia ricini* is a fabric of good quality. In recent years, the techniques of rearing eri silkworm with leaves of *Manihot utilissima* and *Coriaria sinica* have been greatly developed. Studies and rearing technique of the Japanese silk moth *Antheraea yamamai* have made good progress and the prospects of exploiting this kind of precious silk look well.

Apiculture in China has a long history. At present there are about 7 million colonies of honey bees in China. The export of honey and royal jelly occupies the leading position in the world. Chinese aphid nuts produced by gall aphids *Melaphis chinensis* and *Narudea* spp. are traditional commodity in China. There are 14 spp. gall aphids in the world, all of them are found in China and most of them are Chinese endemic species. Production and export of both Chinese gall nut and white wax produced by white wax scale *Ericerus pela* in China take the leading place in the world. There are 5 *Laccifera* spp. in China. The lac production of China is ranked at the third place in the world.

**2.3.3 Materia medica** There are a lot of insects used as medicines in China. One of them is the Chinese caterpillar fungus, which takes an important position in the international trade. Twenty six *Hepialus* spp. , which are hosts of Chinese caterpillar fungus *Cordeceps sinensis*, have been found in western mountainous regions, most of them are Chinese endemic species. Not long ago, artificial rearing of *Hepialus oblifurcus* had been

successfully carried out in Hangzhou, Zhejiang of low altitude. Cockroach *Eupolyphaga sinensis*, which takes a certain position in international trades, is also artificially mass-reared in China.

**2. 3. 4 Food insects** There are hundreds of species of edible insects in China. Food products of such as Spingid larvae, Chinese rice grasshopper and drone pupae of honey bee have been exported in large quantity as commodities. Mulberry silkworm pupae, oak silk worm pupae, cicadas and larvae of yellow meal worm *Tenebrio molitor* used for raising birds and scorpions are also on sale in market. Insect tea is also a traditional commodity of international trade, which is made of frass of yellow-strip dark noctuid *Hydrillodes morsa* and black rice worm *Aglossa dimidiata*; both species feed on medicinal plants such as *Malus sieboldi* and *Platycarya strobilacea*. Insect tea has effects of cooling after drinking and is particularly favored by workers in hot environments of South-East Asia.

**2. 3. 5 Prize and favored insects** The species number and populations of prize insects with trade value are quite big in China. For example, there are 37 *Parnassius* species of Parnassiidae in the world, of which 27 species have been found in China. The celebrated *Parnassius apollo*, extinct in some European countries, is relatively common in western China, thousands individuals of which had been found there. There are 7 spp. of the world famous *Bhutanitis*, 6 spp. of which have been found in China. The colony size and number of *B. mansfieldi* and *B. thaidina* are found still quite big. There are 4 spp. of *Luehdorfia* in the world, 3 spp. of which have been found in China. The populations of *L. chinensis* and *L. longicaudata* are still quite big in wild. There are only 2 spp. of *Teinopalpus* of Papilionidae in the world, both of which are found in China. For the prize *T. aureus*, it had been recorded only by several specimens, only recently more specimens of which have been collected from South China. There are also 2 spp. of the large size and beautiful *Agehana* in the world. *A. maralo* with a restrictive distribution in Taiwan Province has been listed as first category protected animal and its population is very small. *A. elwesi* with a distribution in eastern and central China can be observed quite often in wild. The only two species of *Sasakia* of Nymphalidae are all found in China. The rare *S. charonda*, designated as the state butterfly of Japan and first category protected animal in Taiwan Province, can still be occasionally observed in the lower Yangtze valley of China.

### 3 CHARACTERISTICS OF CHINA'S FAUNA AND FLORA AND THEIR FORMATION

China is a country with vast territory. The ecological and geographical conditions of different regions are quite different, the temporal and spatial changes of these conditions in historical developments are very complex. The geological events from the Quaternary,

especially the elevation of Qinghai-Tibet plateau and the big ice-coverage happened in the north hemisphere have strong effects on the formation and development of the present fauna and flora of China. The facts that only ice-coverage of relative small area happened in North China and nearly without any ice-coverage in most part of South China account for the sustenance of huge number of relict species in China, such as Giant Panda.

### **3.1 Endemicity and adaptability to the geographical and climatic conditions of China**

#### **3.1.1 The boundary line of the Palaearctic and Oriental Realms within China**

China spans over the Palaearctic and Oriental Realms. Although there exist many different views about the boundary line between the two realms in China, the most accepted one can be defined roughly as: it begins in the west from Mt. Himalaya and goes eastwards to Mt. Qinling, then along the Yangtze River till its estuary. Along this line natural environments are quite different from place to place, especially in the west mountainous areas the vertical distribution should be taken into consideration besides the horizontal division.

**3.1.2 In the eastern region** The fauna and flora of the eastern region of China is characterized by element penetrations and mixtures of both Palaearctic and Oriental Realms. In the East along the Yangtze River the topography consists of mainly low hills and plains, no natural obstruction exists, and climate changes only gradually. Thus a vast transitional zone is formed, in which species from both Realms mix and penetrate. For example, 80 families of 100 plant families distributed in the south extend in different degrees towards north.

For insects there are also a lot of similar examples; insects widely distributed in Siberia can extend to the area with the north latitude less than 30 degrees; the true tropical species extend northwards to the Yellow River, such as grassland type locusts of the middle and minor Asia also occur in meadows of coastal regions; some Indo-Malaysian species, such as *Coptosoma cribraia* Fahr. and *Allomyia dichotomus* L., may extend to the Yellow River and Huaihe River valleys.

**3.1.3 In the Qinghai-Tibet region** This region is the unique high and frigid plateau in the world, with an average altitude of over 4 000 m above the sea level. During the elevation process of the plateau, some species of insects gradually adapted and survived in this extremity environment or became diversified and endemic to the plateau. For example, in Qinghai-Tibet Plateau there are 200 spp. and subspp. of Tetrigoidea, Eumastacoidea and Acridioidea, of which 102 spp. are endemic to this area. For adaptation to the special environments many changes had happened in body structures of all these endemic species; 87 spp. wings reduced, nearly devoid of function for flying, of them 35 spp.

apterous; wing lobiform-lateral, 30 spp. elytra and wing lobiform; 22 spp. brachypterous capable of sailing, 15 spp. with fully developed wings capable of flying; 74 spp. with small size; 54 species without sound organs, 39 spp. without tympana; most species univoltine; distributed in restricted patchy or island areas; body size becoming smaller with the increase of elevation level (Yin 1984). In genus *Leptomias* Faust (Coleoptera, Curculionoidea), of all 93 spp. of the world, 74 spp. endemic to the Himalaya region; 55 spp. endemic to Tibet, equivalent to 59% of all known species or 74% of all species endemic to Himalaya area (Chao and Chen 1981). In Hepialidae (Lepidoptera), all species inhabit at high and cold area of elevation over 3500 m above the sea level; of 21 spp. recorded in China, 12 spp. described from and endemic to Qinghai-Tibet Plateau, equivalent to 57.14% of all species from China.

**3.1.4 In south-western region** As the most humid and warm region in China, this region includes the eastern part of Himalaya area and the northernmost edge of the tropical area in S. W. Yunnan Province. Insects are of very high diversity and many of them are of archaic type. In Namjagbarwa of S. E. Tibet, where the environment is quite stable and the flora is very rich, 2 000 species of 19 insect orders have been recorded, almost equivalent to 80% of all species recorded in Tibet. Of the 2 000 spp. 23% are endemic to Medog region, such as *Chondacris rosea brunneri*, *Ceracris versicolor* Brunn. and *Phlaeoba sikkimensis* Ramme. Archaic groups, such as Odonata, Ephemera, Mantodea, Blattaria and Isoptera, are distributed here. The only 2 spp. of Zoraptera from China were found here.

Although the area of Xishuangbanna, S. Yunnan Province, amounts to only 0.2% of the total land area of China, the biodiversity contribution from this place to China reaches quite high proportions: higher plants over 4 000 spp., about 7% of the total of China; mammals 102 spp., 21.7% of the country total; birds 402 spp., 33.9% of the country total; fishes 1 000 species, 35.2% of the country total; amphibians 36 spp., 16.4% of the country total; and reptiles 63 spp., 16.6% of the country total. The diversity of insects will be indicated by following figures and proportions: Hispididae 417 spp. in China, 256 spp. in Yunnan Province equivalent to 61% of the country total (Chen *et al.* 1986); Apoidea 185 spp. in Yunnan, 111 spp. in Xishuangbanna equivalent 60% of the Yunnan Province total.

**3.1.5 In the Xinjiang Uygur Autonomous Region** This is the most arid region in China, where mainly the typical species endemic to the middle Asia are distributed. In 11 genera of Panphagidae, except the genus *Haplotropis* of a wider distribution, all other 10 genera are restrictively distributed in N. W. China, of which 5 genera are endemic to Xinjiang (Liu 1990). The genus *Sphingonotus* of Acrididae is a typical group distributed

in Mongol-Xinjiang region, of which 75 spp. are known from the world, 33 spp. are recorded in China, 21 spp. (64.2% of all species recorded in China) are recorded in Xinjiang, 14 spp. (64.2% of all species recorded in Xinjiang) are endemic to Xinjiang (Huang 1990). The genus *Proxylocopa* of Apoidea is distributed only in N. Xinjiang and desert steppes of the middle Asia.

**3.1.6 In the Daxinanling mountainous region** As the most humid and cold area in China and in N. E. Asia either, the region extends northwards to E. Siberia. The insect fauna there consists mainly of the typical Palaearctic species. The only species of Grylloblattodea in China, *Gralloisiana sinensis*, was found at Mt. Changbai, which is a primitive insect of the high, humid and cold zone and very rare. In the family Amphizoidae of Coleoptera, 5 spp. are known in the world, all living only in torrents of cold area, and the only species in China, *Amphizoa sinica*, is distributed only at Mt. Changbai.

### **3.2 South-west mountainous region as the important origin and diversification center of China's fauna and flora**

The south-west mountainous region in China is an area where mountains running from north to south direction and from east to west direction are overlapping. Its long geological history, complex changes in three dimensions (i. e., latitude, longitude and altitude) and peculiar natural geography conditions afford favorable conditions for species distribution and speciation, known as "the crossroads" of the north and south fauna and flora. Due to no formation of big ice-coverage in history and natural zonation along altitude, comparative stable environments favorable to species sustenance and diversification are formed. This is an area with the most abundant species diversity and the highest endemism of genera and species as well as the most active speciation in China. In books "Insects of Hengduan Mountains Region" (The Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, Chinese Academy of Sciences, 1992, 1993), 4 758 species in 1 971 genera of 230 families of 29 insect orders are recorded. The main characteristics of the region are summarized as following.

**3.2.1 Characters of alpine fauna and flora distinctive; endemic genera and species abundant** Alpine species are formed by adaptations to alpine environments. Genera of alpine distributions in Holarctic or Palaearctic Realm are present here in comparative congregation. As the representative species of alpine adaptation, the apterous species of locusts in Hengduan Mountains amount to 35 spp. of 12 genera, as many as 2/3 of the total apterous locusts in the Qinghai-Tibet Region (Yin 1984). Of 4 genera of Galerucinae (Coleoptera: Chrysomelidae) 17 spp. were recorded in this region, which represent 74% of the recorded alpine species of the subfamily in the Qinghai-Tibet Region (Wang and



Tan 1992). The species of the genus *Halictoides* of Apoidea are mainly distributed in high mountains and plateaus in Holarctic Realm, and the species of the genus recorded in Hengduan Mountains represent 44.4% of the total in China. Table 3 indicates the percentages of endemic genera to the total recorded genera in Hengduan Mountains are between 7.6%-30.4% with Acridinae at the top. The endemic species are of higher percentages (see Table 4).

**Table 3** Statistics of some endemic genera in Hengduan Mountains (cf. Wang and Tan 1992)

Taxa	Recorded Genera (RG)	Endemic Genera (EG)	EG/RG %
Orthoptera Acridinae	23	7	30.4
Orthoptera Pyrgomorphina, Oedipodinae and Catantopinae	40	9	22.5
Coleoptera Chrysomelinae	37	5	13.5
Coleoptera Galerucinae	43	5	11.6
Coleoptera Cerambycidae	66	5	7.6

**Table 4** Statistics of endemic species of some groups in Hengduan Mountains

Orders	Families	Recorded Spp. (RS)	Endemic Spp. (ES)	ES/RS %
Diplura	2	2	2	100.0
Phasmatodea	2	6	5	83.3
Orthoptera	3	140	70	50.0
Homoptera	7	359	184	51.3
Hemiptera	5	214	44	20.6
Coleoptera	9	790	364	46.1
Lepidopera	8	864	261	30.2
Apoidea	6	143	58	40.6
Diptera	3	408	141	35.1
Trichoptera		84	45	53.6
Neuroptera		59	42	71.2

**3. 2. 2 Archaic and primitive groups are abundant** Of *Rhyacephilia*, one of the primitive groups of Trichoptera, 17 spp. were recorded in Hengduan Mountains, as many as 20% of the total species of Trichoptera. Of Megalopodinae, the most primitive group of Chrysomelidae, 5 species have been recorded in Hengduan Mountains, as many as 23.8% of the total recorded species in China. Of the genus *Stenoluperus*, the most primitive genus of Alticinae of Chrysomelidae, 9 spp. have been recorded from Hengduan Mountains, as many as 60% of the total recorded species in China. Of Hepialidae, one of the primitive groups of Lepidoptera, half of the recorded species in China are also distributed in this region.

**3. 2. 3 Vertical zonation distinct; mutual penetrations of Palaearctic and Oriental elements forming overlapping characteristics** The vertical distributions in Hengduan Mountains are characterized by: the high altitude zones above 3 200 m are dominated by Palaearctic elements and endemic species; the lower zones of altitude beneath 2 800 m are dominated by Oriental elements and widely distributed species; the faunal compositions of the zones between are of mixture and penetration of elements from both higher and lower zones. For different groups their vertical distribution may be of quite different patterns. For example, 67% species of Acridinae are distributed between altitudes 3 300-4 700 m, but 70% species of Pyrgomorphinae, Catantopinae and Oedipodinae are distributed in altitudes less than 2 900 m.

Generally speaking, more species (about 30% of the total) are distributed in the evergreen broad-leaved forests of altitudes between 2 000-2 800 m.

The steep valleys in the north-south direction in Hengduan Mountains facilitate the movements of faunal elements between the north and the south. For example, the genus *Dasypoda*, a typical Palaearctic genus and distributed in Inner Mongolia Autonomous Region and Xinjiang Uygur Autonomous Region, reaches southwards to Barkam (alt. 2 600 m, lat. 32° N) of Sichuan Province; *Anthidium montanum*, originated from Europe, is also distributed in mountains of Kangdin (alt. 3 650-4 300m, 30° N); and the genus *Ctenoplectra*, a typical Oriental genus, extends northwards to Moxi (29°N) of Sichuan Province. Because of the effects of the above elements, the boundary line of the Palaearctic and Oriental realms in this area proceeds in a zigzag form.

#### 4 STATUS OF BIODIVERSITY RESEARCHES IN CHINA

In last 40 years, quite a lot of data and achievements have been accumulated in research fields of taxonomy, biogeography, bioresource, genetics, ecology and environmental sciences in China, with which our basis for biodiversity researches is built. In recent several years biodiversity researches such as bioinventory and database, survey on endan-

gered species and analysis of threats, conservation biology of rare species and sustainable uses of bioresources have been carried out and distinct progress has been made.

#### 4.1 Comprehensive expeditions

In last 40 years Chinese Academy of Sciences has sponsored many multi-disciplinary comprehensive expeditions at national or regional level, which cover nearly all territory of China: arid lands of Xinjiang in the north-west, high and frigid plateau of Qinghai and Tibet in the south-west, parallel arranged mountains and valleys with abundant species diversity in Hengduan Mountain region, the north edge of the tropics in Yunnan Province and Hainan Province, humid and cold areas in the north-east and grasslands of Inner Mongolia Autonomous Region. Surveys on insects are involved in 14 expeditions. According the present statistics, 20 million specimens of organisms have been collected, of which 3.4 million specimens are of animals and 1.8 million specimens of plants. Institute of Zoology, Institute of Botany and Institute of Microorganism of Chinese Academy of Sciences are the centers for the deposition of these specimens, and some other special group or regional deposition centers are established in universities or colleges of different regions. 3.5 million pinned specimens of insects and type materials of 3 781 spp. and sub-spp. are deposited in the Insect Collection of Institute of Zoology, Chinese Academy of Sciences (Yang *et al.* 1991). Parts of the results of the above mentioned expeditions have been published in monographs, such as: "Insects of Xizang" (The Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, Chinese Academy of Sciences, 1981, 1982; 2 volumes, 2 307 spp. included), "Biota of the Mt. Tuomuer in Tianshan Mountains" (The Mountaineering and Scientific Expedition, Academia Sinica 1985; 408 spp. included), "Insects of Mt. Namjagbarwa Region of Xizang" (The Mountaineering and Scientific Expedition, Academia Sinica 1988; 1987 spp. included), "Insects of Hengduan Mountains Region" (The Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, Chinese Academy of Sciences, 1992, 1993; 2 volumes, 4 758 spp. included) and "Insects of Wuling Mountains Area, Southwestern China" (Huang 1993).

Under the organization of Chinese Academy of Sciences, 91 volumes of "Flora of China", 2 volumes of "Cryptogamia of China" and 57 volumes of "Fauna Sinica" have been published respectively by the Editorial Committee of Flora Sinica, the Editorial Committee of Cryptogamia Sinica and the Editorial Committee of Fauna Sinica, Academia Sinica, and these projects are still going on. Forty fascicles of "Economic Insect Fauna Sinica" have also been published by the Editorial Committee of Fauna Sinica, Academia Sinica. All these books on flora and fauna of China form the basis for the inventory of species diversity in China.

## 4.2 Inventory of rare and endangered species

Red Lists and Red Data Books of rare and endangered species in China have been published or in compilation. "China Plant Red Data Book" (vol. 1) has been published in 1991. "Catalogue of China's Key Protected Wild Animals" has been approved and published by the state government, in which 15 spp. of insects are included. The compilation of "Red Data Book of Animals in China" is being carried out. The edition of "Red List of Insects in China" is planned.

## 4.3 Ecological research stations

Over 100 field stations related to biodiversity studies have been established by Chinese Academy of Sciences and other institutions for biological and ecological observations and experiments. In Forest Ecological Research Station of Mt. Changbai and Grassland Ecological Research Station of Inner Mongolia, researches of insect community structures and successions have been performed systematically for a long period.

# 5 STATUS OF BIODIVERSITY CONSERVATION IN CHINA

## 5.1 Threats

With the increases of Chinese population and rapid developments in economic reconstruction, natural resources have suffered serious damages, natural environments become deteriorated and large number of animals and plants become endangered and some extinct. Forests containing abundant biodiversity have been destroyed seriously. Forest coverage has been reduced to 13.92%. In 1950s tropical rain forests and tropical seasonal rain forests covered a large area of Xishuanbanna, about 50% of the land area in the region. But in recent decades, due to extensive destruction of primary forests and transforming them for planting tea and rubber trees, the primary ecosystems are destroyed, forest coverage is reduced to 28% of the land area in Xishuanbanna, the forests are lost at the speed of over 1300 hectares per year, birds and mammals become fewer and insects easily captured in 1950s become rare or completely disappear. The deteriorated grasslands amount to about 1/4 of the total grasslands in utilization. Over-exploitation leads to rapid decreases of some bioresources: the productions of the Chinese caterpillar fungus in Qinghai-Tibet Plateau and populations of *Bhutanitis thaidina* are quickly decreasing. Pollution and improperly uses of chemicals have put a lot of natural enemy and pollinating insects into endangered conditions. In a primary estimation, 15%-20% of the faunal and floral elements are endangered in China, 10%-15% higher than the average level of the world.

## 5.2 Conservation

Since the founding of P. R. China in 1949, a good deal of legislation work related to

bioresource conservation have been done. In “The Constitution of the People’s Republic of China”, it is stipulated that the state guarantees the rational utilization of natural resources and protects rare animals and plants. A series of laws and regulations on natural conservation, such as: “Catalogue of China’s Protected Rare and Endangered Plants” (1984), “Catalogue of China’s Key Protected Wild Animals” (1985), “Laws on the Protection of Wild Animals of the People’s Republic of China” (1988) and “The Enforcement Regulations on the Protection of Terrestrial Wild Animals” (1992) have been issued by the state government of China, which provide the legal basis for China’s biodiversity conservation. “The Biodiversity Action Plan of China” issued in 1994 will further promote the conservation works of China’s biodiversity.

**5. 2. 1 In-situ conservation** In 1956, China’s first nature reserve, the Guangdong Dinghushan Mountain Nature Reserve, was established in Guangdong Province by the Chinese Academy of Sciences, setting a good example for in-situ conservation of China’s biodiversity. By 1991, 420 nature reserves of the total area about 44 million hectares, 4.5% of the state land area, are established in China, some of them are members of MAB. Most of the reserves are set mainly for protecting plants in priority, secondarily rare and endangered animals such as Giant Panda, Golden Monkey, Japanese Deer, Chinese Alligator, Crested Ibis, and Takin. No enough attentions are given to in-situ conservation of insects. Till now, only two reserves are established in the purpose of protecting insect resources for sustainable exploitation and production: the Protection Area of Japanese Silk Moth *Antheraea yamai* in Ningan, Helongjiang, N. E. China and the Protection Area of a variety of *Apis mellifera* in Huocheng County, Xinjiang Uygur Autonomous Region, W. China. A patch of forest land are delimited in the suburb of Nanjing for protecting the butterfly *Luehdorfia chinensis*, which sets the first example for protecting rare and endangered insects. In recent years biological and ecological studies on endangered butterflies, *Luehdorfia chinensis*, *L. longicaudata* and *Teinopalpus aureus*, have been carried on for providing the scientific basis of protection measures. Due to insufficient attention and improper management to rare and endangered insect resources, over-exploitation and even poaching occasionally happen and seriously damage the valuable resources.

**5. 2. 2 Ex-situ conservation** In China 110 botanical gardens and over 400 propagation bases and germplasm banks for the ex-situ conservation of rare and endangered plants have been established. For the ex-situ conservation of animals, 38 zoos and 230 plus breeding farms for wild animals and 16 breeding centers for rare and endangered animals have been set up, which contribute much towards the restoration of populations of some endangered animals, such as Giant Panda, Crested Ibis and Manchurian Tiger. Artificially breeding of over 60 endangered animals have been successfully conducted. Compared

with plants and vertebrates, only a little has been done in ex-situ conservation of insects, successful programs of which include: the mass-breeding of *Papilio bianor takasago* in Liaozhong, Liaoning Province for trade purpose; artificially breeding of prize butterflies *Troides aecus*, *Agehana elwesi*, *Luehdorfia chinensis* and *L. longicaudata*; breeding *Luehdorfia chinensis* with artificial forages.

## 6 RECOMMENDATIONS ON CHINA'S INSECT DIVERSITY CONSERVATION

### 6.1 Insect species survey and inventory

For protecting insect diversity, the first thing to do is correctly identifying species. Only 45 000 spp. of insects are recorded in China. It is a giant and long-period task to survey and identify the rest Chinese insects (Wu 1992b, 1992c, 1993). In the coming years, the most urgent works for taxonomical studies of insects in China should include: training of more professionals on insect taxonomy; comprehensive surveys of insect species in priority areas selected in consideration of faunal representativeness. Following sites are the suggested priority area; Changbai Mountains of the Palaearctic characteristics; Qingling Mountains of the overlapping areas of the Palaearctic and Oriental Realm; Hengduan Mountains and Xishuangbanna, two regions with the highest insect diversity in China; the south-west area of Hainan Island of the Oriental characteristics.

### 6.2 In-situ conservation of rare insects

It includes strengthening the management efforts of the two above mentioned insect reserves, and enlarging the protected area of *Luehdorfia chinensis* in Nanjing for transforming it into a butterfly reserve. Establishing *Apis cerana* reserve in Aba, W. Sichuan Province. Providing the lists of key insects with conservation needs in all 400 plus nature reserves in China. The following species should be included in priority; *Gralloidiana sinensis* and *Amphizoa sinica* in the Changbai Shan nature reserve; *Luehdorfia chinensis* and *L. longicaudata* in the Taibai Shan nature reserve; *Hepialus* spp. and *Parnassius* spp. in the nature reserves of Hengduan Mountains and Qinghai-Tibet region; *Troides* spp. in the nature reserves of Xishuangbanna; *Bhutanitis* spp. in the nature reserves of Gongga Mountains, Sichuan Province; *Teinopalpus aureus* in the nature reserves of Hainan Island; *Teinopalpus aureus* and *Agehana elwesi* in the Wuyishan nature reserve; and *Sasakisa funebris* in Wuling Mountains.

### 6.3 Biological and ecological studies of rare and endangered insects

Systematically studying the distribution, population size, biotope, biology and ecology of rare and endangered insects, finding suitable circumstances for their living, identifying threats and endangered levels, providing scientific basis for their management and

conservation, and developing techniques of farming and ranching of insects (especially butterflies) if possible and suitable. The following species should be taken as priority species for the studies; *Bhutanitis* spp. , *Agehana* spp. , *Sasakia* spp. and *Parnassius* spp. On the basis of ecological studies, continuing artificially breeding of rare and endangered species for their sustenance is necessary; in certain suitable nature reserves, artificially breeding individuals may be released to wild for increasing the natural populations.

#### 6.4 Legislation and enforcement of laws related to insect conservation

In "Catalogue of China's Key Protected Wild Animals" (1985), only 15 spp. of insects are included, of which 5 spp. are butterflies. This is quite incompatible with the actual status of Chinese insects bearing in mind of the ever intensifying threats to insects. It is urgent to revise that catalogue, to compile and publish the China's Insect Red List and Red Data Book to supply the legal justifications for monitoring and management of insect trades. Public awareness of the importance of protecting insect diversity needs to be more promoted; and the enforcement of the related laws needs to be strengthened.

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## 中国生物多样性与保护:昆虫学家的观点

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中国是世界12个生物多样性巨丰的国家之一,也是亚洲及太平洋地区生物多样性和特有性最高的两个国家之一。中国具有世界最高的山系和许多不同的生物栖息环境,跨古北和东洋两界。这些特征可用来说明其丰富的物种多样性和高特有性,迄今中国已报道的昆虫种类约为45 000种。特有成分明显多于周边国家。特别是西南山地和热带地区,特有成分比例很高。人类干扰,栖息地丧失、森林减少和污染等迫使未知数目的种类处于濒危状态或已灭绝。本文提出了中国昆虫保护的建議,包括:鉴别优先保护对象,开展濒危物种的生物学和生态学研究,监测栖息地和多样性的丧失,编制珍稀和濒危物种“红色名录”和数据库,建立昆虫保护区,开发昆虫人工饲养和繁殖技术。

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