

Geographic Diversification of Biota in the Continent of China*

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At the highest level, one major parameter dealing with diversity of species should be the large-scale variations in natural environment, which influences plant and animal distributions, and coexists in different regions with different characteristics of biodiversity. This happens to be true in vast territory, such as the continent of China.

Apart from the pan-tropic and pan-boreal patterns, suggested by the author (Zhang, 1979), the most obvious patterns in the distribution of land vertebrates in China (Fig. 1), is a tendency of geographical diversification, for plants and animals on the whole. This occurs in response to variation in the physical environment with particularity of geological history. For further study of biodiversity of China, the suggestion could be regarded as hypothesis based on the existing knowledge of previous studies.

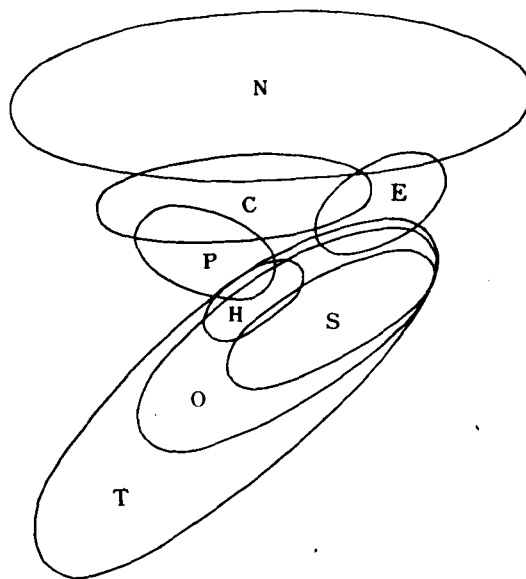


Fig. 1 The distribution patterns of land vertebrates of China

Note: N: Boreal. E: Northeast. C: Central Asian. P: Plateau. T: Old world Tropic. O: Oriental (Tropic-Subtropic). S: Southern China. H: Hengduan-Himalayan.

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1 Transition of Palaearctic and Oriental Realms

From a global point of view, flora and fauna of China can be divided into the Palaearctic and Oriental realms and have been recognized by early phytogeographers and zoogeographers, but with different opinions of their delimitation, except for the line along the Himalaya Range which, apparently, creates an insurmountable barrier. To the east of the Himalaya, north-south migration of the two realm elements had happened in response to climatic oscillations (Zhang, 1988), especially, the elements belonging to big families of Pan-tropic, Old world tropic or Oriental extended to the north of Jingling Range and Huihe river, even reaching the areas of North China or Northeast China (Wu et al., 1983; Zhang, 1979). The most representative species are as follows:

Plants:	Birds:	Mammals:
Moraceae	Threskiornithidae	Molossidae
Euphorbiaceae	Trogonidae	Cercopithecidae
Gesneriaceae	Captionidae	Viverridae
Lauraceae	Nectarinidae	Manidae
Rubiaceae	Pittidae	Platacanthomyidae
	Irenidae	

The southward shifting of the Palaearctic elements could be represented by *Carpinus*, *Berberis*, *Ribes* and *Pyrola*, etc. of angiosperms and *Talpa*, *Melels*, *Eutamias* of mammals, *Alauda*, *Prunella*, *Gavia* of birds, *Tylotriton* and *Megophrys* of amphibians etc. The admixture with the elements of the both realms resulted in a transitional characteristic of the biota in the eastern part of China.

2 Polarization of endemic centers

Since the middle Tertiary, the uplift of the Himalaya and the Tibet Plateau, an important event of environmental change in the east Asian continent, has intensified consequently the differentiation between the eastern and western parts and vertical zonation in the southwest. Perhaps, in the post-pleistocene, the strong monsoon climate has originated (Liu et al., 1984). Stimulated by these geologic and palaeogeographic processes, environmentally polarizing diversity has developed and four relatively extreme climatic centers around the continent of China are created. They coincided with that four present endemic centers. It could be reflected by the distribution patterns (Fig. 1) and mammalian fauna (Zhang et al., 1985):

2.1 Cold-humid Northeastern Asia (pattern E): Certain species of *Sorex* of insectivores, *Microtus* and *Clethrionomys* of rodents;

2.2 Arid Asian Inland (pattern C): *Equus* and *Procapra* of ungulates, Dipodidae, Cricetinae, *Meriones* and ground squirrels of rodents;

2.3 Hot-humid Southeastern Asia (patterns S, O and T): Primates, Pangolins, Viverridae and many species of rodent families, such as flying squirrels, arboreal squirrels, old world porcupines and bamboo rats;

2.4 Frigid Tibet Plateau (pattern P): Rising of species adapted to cold environment, represented by species of *Ochotona* of lagomorphs and *Pitymys* of rodents, *Poephogus* and *Pantholops* of ungulates.

3 The "Panty Ground" of refugium

There is an agreement that in northern Eurasia during the biggest glaciations, the continental glaciers in the eastern part reached to the Great Xingan mountains, Northeast China. As a result, the southward expansion of Asian polar frontal zone induced displacements of fauna and flora. The warm-preferring Palaeoartic fauna and flora in Tertiary were largely destroyed, except for part of them being able to reach the south of Eurasia of the subtropical area, of which the southeastern China served as a land of refuge — "Pantu Ground" (Kahlke 1961). Those Tertiary species which survived as relics occurred in the areas of central and southern China. The most famous of them are *Ginkgo biloba*, *Metasequia glyptostroboides* and *Cathaya argyrophylla*, *Pseudolarix amabilis*, *Pseudotaxus chienii* among plants, and *Ailuropoda melanoleuca*, *Budorcas taxidor* of mammals and *Alligator sinensis* of reptiles. The land of this part in China has developed with relatively stable biotopic environment, more diverse biota with abundant endemic genera and species has been presented (Wu et al., 1983; Zhang, 1979).

4 Diversification center of the Hengduan Mountains

In the vast territory of southwestern China, the Hengduan mountain area with gorges and ridges in pronounced reliefs has developed numerous spectrums of vertical zonation alternating in a three — dimension and harbouring diverse biocommunities.

The high species diversity and endemism in this region have been often mentioned. *Rhododendron*, *Primula*, *Gentiana*, *Acronema*, *Pternopetalum*, *Loxostemon*, *Solmslaubachia*, *Megacoden*, *Veratrilla*, *Omphalogramma*, etc. represent a wide range of families of flowering plants (Wu et al. 1983), and of Fungi, Moesses and Fern flora (Zang et al. 1981, Gao et al., 1981; Qin et al., 1981). A study on floristic structure of the Hengduan region confirmed that there are 64 endemic species which belong to 37 genera and 21 families in dicotyledon (Le et al., 1984). Of land vertebrates, most species of *Megophrys*, *Scutigera*, *Oreodax* of amphibians, and *Garrulax*, *Yuhima*, *Phylloscopus* of Birds and *Ochotona*, *Soriculus*, *Eothenomys* and *Cervus* of mammals are distributed geographically overlapping in this region (Zhang et al., 1985).

Agreed by most Chinese scholars in the field of palaeogeography and glaciology, the strong uplifting of Himalayas and the Tibet Plateau caused climatic condition of west China to become drier, therefore, seriously restricted the development of glaciers. The glaciers in west China never developed to the size of those in the European Alps (Shi et al., 1979). That means, although the depression of upper nature zones, the mountain landscape of vertical zonation below the snowline must still remain a wide amplitude with the base feature. One can find some of the extant glaciers in the mountains penetrate into the zone of dark coniferous forest and along the same valleys and reach down to the subtropic evergreen broadleaf forest only within a vertical range of 500m. Assuming that the

depression of the Pleistocene snowline is 600m. as suggested by some authors (Shi et al. , 1979), the extension of the glaciers and the alpine tundra must have not induced to wipe out any individual zone from the whole vertical spectrums. Nevertheless, the shrinkage of the zonation must take place, there is no reason to presume that the basic picture could be much different from the present. As indicated by the present wide amplitude of each major zone, especially the lowest ones, which range from 200 to 1500m, it shows a high potential to experience vertical shifting of the zonation. And since the decline of the maximum glaciation in post-later-Pleistocene, expansion of the vertical zones can be traced by the retreat and disappearance of the glacier, but the alpine environments still remain. Undoubtly, the vertical shifting of zonation can not be comparable with that of horizontal in the east China. It could be only one thousandth of the latter. So, the Hengduan region must have changed little and have been the most stable environment since the Pleistocene. The species of the most distribution patterns could be easily spread there and find habitats available in the most diverse mountain environments by the gate of south-north trend valleys and the highway of the alpine ridges. Therefore, the overlapping center of most distribution patterns has formed, in other words, it provides a most favourable refuge for different ecological groups and gives a most suitable ground for phylogenetic diversity of some vital groups as a recent center of speciation.

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