DISTRIBUTION OF ELEPHANT IN XISHUANGBANNA DAI AUTONOMOUS PREFECTURE, CHINA

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Introduction

Until about the end of the 10th century AD, the Asian elephant *(Elephas maximus L.)* enjoyed wide distribution and good numbers in the Chang Liang (or Yangtze) river valley where it was so numerous that considerable number of animals were hunted for their ivory and hide by non - Chinese (Laufer, 1925). The hills of the northern part of China were once heavily forested and hence provided suitable habitat for a variety of large mammals including the elephant. Given the ability of the elephant to withstand low winter temperatures (Elwes, 1916), it is not surprising to know that the animals may have once extended their range in China as far north as the Huang He or the Yellow river (Olivier, 1978). On the basis of its apparent darker colour and reddish ivory, Deraniyagala (1955) ascribed it to a different subspecific status naming it as *Elephas maximus rubridens* to distinguish it from the forma typica *Elephas maximus maximus* of Sri Lanka and *Elephas maximus indicus* found in rest of the Asian mainland.

In a country such as China, where for more than 70 centuries the human population has been engaged in tilling the land, agriculture is and had always been the most important form of human activity exerting the greatest impact on the land (Zhao, 1986). One of the consequences of the rapid increase and spread of the human population in China has been the elimination of many large mammalian populations from their former range. Increasing human population and increasing agricultural land use have considerably reduced the area that was once available to the elephant and today, populations of elephant are confined to the southern part of the Yunnan Province in the Xishuangbanna Dai Autonomous Prefecture (Fig. 1) where the remote and yet forested hills provide the last refuge (Xu, 1987; Santiapillai & Jackson, 1990).

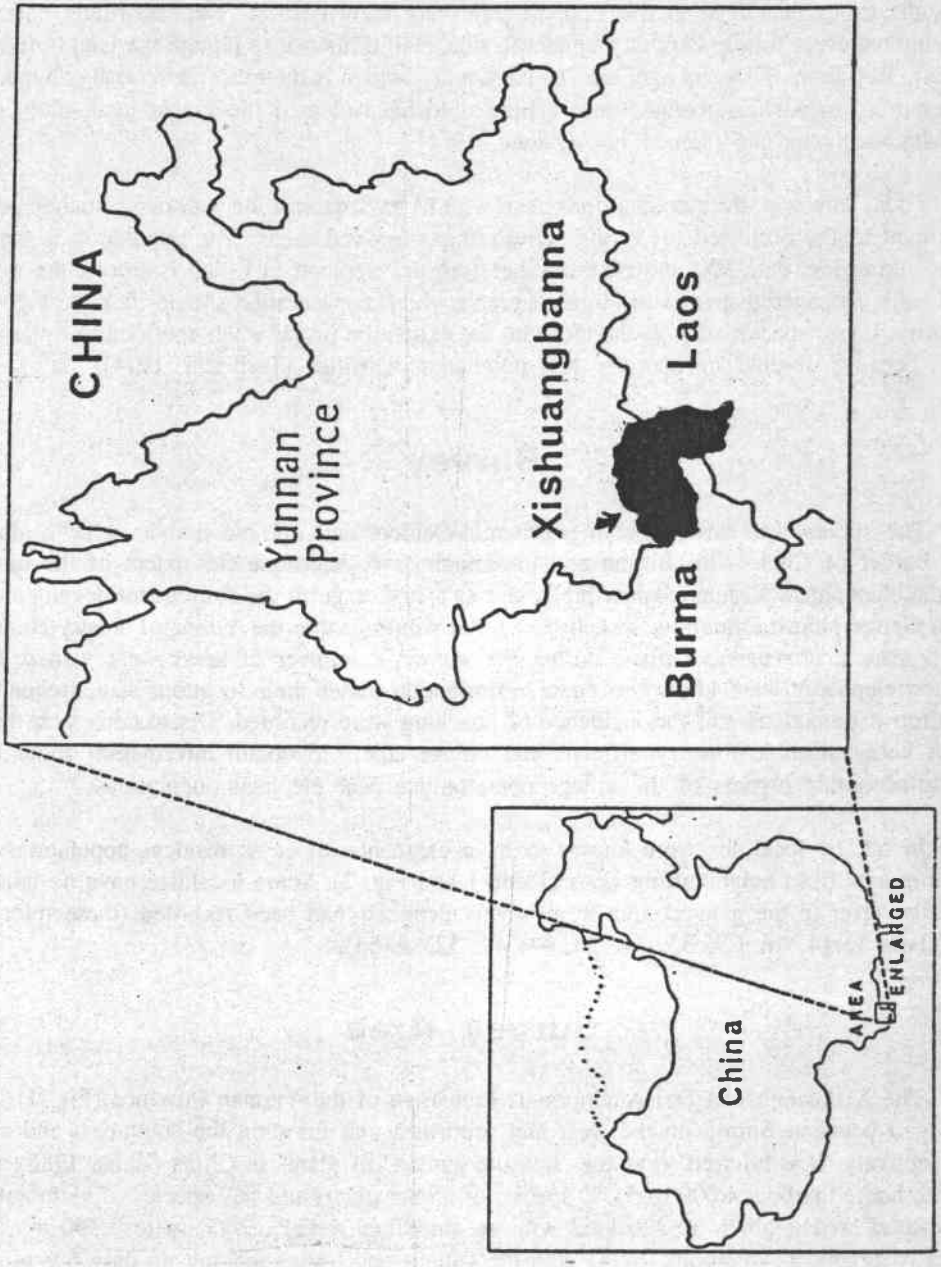


Fig. 1. Map of China showing the relative position of Xishuangbanna Dai Autonomous Prefecture in the Yunnan Province.

The south-western province of Yunnan had a great reputation as an elephant area. Marco Polo referred to it as "swarming with elephants and other wild beasts". As early as 200 BC, the tribes that lived in the Yunnan area were known as an "elephant-riding nation" and almost every family kept an elephant to ride, haul timber or to plough the land (Olivier, 1978). Two thousand years ago, the Dai nationality, which is the most numerically abundant community in Xishuangbanna, were supposed to have cleared the jungle land, ploughed it with elephants and planted rice (Zheng, 1981).

Today however, the elephant finds itself with its back against the wall in Xishuangbanna, confined to the protected areas and some remote forested areas. The population is small (numbering less than 500 animals) and therefore the elephant in China is among the most seriously endangered species of large mammals whose conservation should rank the highest priority. Large species such as the elephant are extinction prone when confined to a limited area because of their intrinsically low population densities (Terborgh, 1974).

Survey

The survey was carried out between mid-October and mid-November in 1991 along the border of China with Burma and Laos mainly to determine the extent of the range of the elephant in Xishuangbanna Prefecture as a first stage in the subsequent development of a Geographic Information System (GIS) that would enable the Yunnan Forestry Bureau to prepare a management plan. During the survey, a number of areas were visited and where elephants were known to occur, information about their location, size, frequency of crop depredations and the incidence of poaching were recorded. Discussions were held with knowledgeable forestry officials and village chiefs to obtain information about the socio-economic aspects of the village communities near elephant populations.

In all, 64 localities were known to have elephants either as resident populations or as migrants from neighbouring Laos (Table 1 and Fig. 2). Some localities have no names as they refer to the general area from where elephants had been recorded (these refer to numbers 1, 14, 26, 27, 33, 34, 38, 44, 49, 52, & 55).

Survey Area

The Xishuangbanna Dai Autonomous Prefecture of the Yunnan Province (Fig. 1) lies wedged between Burma on the west and southwest and Laos on the south-east and east respectively. It is referred to as the "treasure garden" of plants in China (Zhao, 1986) and is the home to about 4,000 to 5,000 species of higher plants and 539 species of vertebrates. The total area is about 19,220 km2 with an altitudinal range of 400 m to 2,300 m. The area is largely mountainous (64%) with the valleys and basins making up only 6% of the area (MacKinnon, 1987). Only about 23-31% of the original forest cover still remains (Zhao, 1986).

One of the conservation problems in Xishuangbanna that has a direct impact on elephant conservation is the conversion of forests to mono-culture rubber plantations. Over 67,000 ha of the Prefecture is under rubber plantations with the possibility of them increasing to 100,000 ha (MacKinnon, 1987). Conversion of forests to rubber plantations, have had a devastating effect on the animal populations especially the large mammals such as the tiger and elephant which on account of the large body size and home ranges are often the first to suffer from range attrition.

Rubber is grown extensively throughout the Prefecture below 900 m altitude. However, the production of rubber is energy consuming: to produce one ton of rubber requires the burning of two tons of firewood in an area characterised by the lack of coal and limited use of other energy sources (MacKinnon, 1987). Forests are the principal source of fuel for both domestic as well as industrial needs in Xishuangbanna. Annual deforestation rate is estimated to be 55,000 ha (Santiapillai & Li, 1991).

Table 1. List of the localities where elephants occur (see Fig. 2)

Number	Locality	Number	Locality
1.	nr. Lancang	2.	Wan Jiao Shan
3.	Yako	4.	Ba Jiao
5.	Kuon Han	6.	Mau Po
7.	Lien Hua Tang	8.	Nang Hang Liu
9.	Da He Shan	10.	Jiang Biao
11.	Da He Bien	12.	Jing Shang
13.	San Cha He	14.	north of San Cha He
15.	Shang Guan Ping	16.	Hong Shan
17.	Do Lok Tang	18.	Yang Liao Pa
19.	Shang Mau Cao	20.	Man Mu Tien
21.	Da Huang Be	22.	Tiao He Ba
23.	Gou Shan	24.	Shu Ling Jai
25.	Ban Ju Lung	26.	west of Xiaohei river
27.	East of Xiaohei river	28.	Ma Ling Su
29.	Man You	30.	Long Fau
31.	Shing Fa	32.	An Lah
33.	near Xiaohei river	34.	near Xiaohei river
35.	Man Ling	36.	north of Man Sa
37.	West of Mahei	38.	Lao border
39.	Lao border	40.	near Yi Tan
41.	Xiang Guen	42.	Hui Lo
43.	Ye Niew Tong	44.	Lao border
45.	Lan Nang	46.	Lan Niang
47.	Da Lung Ha	48.	Mo Xie
49.	Lao border	50.	Ma Long
51.	Dung Fang Hung	52.	west of Shangyon
53.	Hui Bing	54.	Long Man
55.	Lao border	56.	Pham Po Sa He
57.	Sang Tsung Liang	58.	Da Bau Bau
59.	Man Fen	60.	Da Guang
61.	Sang Tien Fang	62.	Lao border
63.	Nong Kwang	64.	Hui Ma

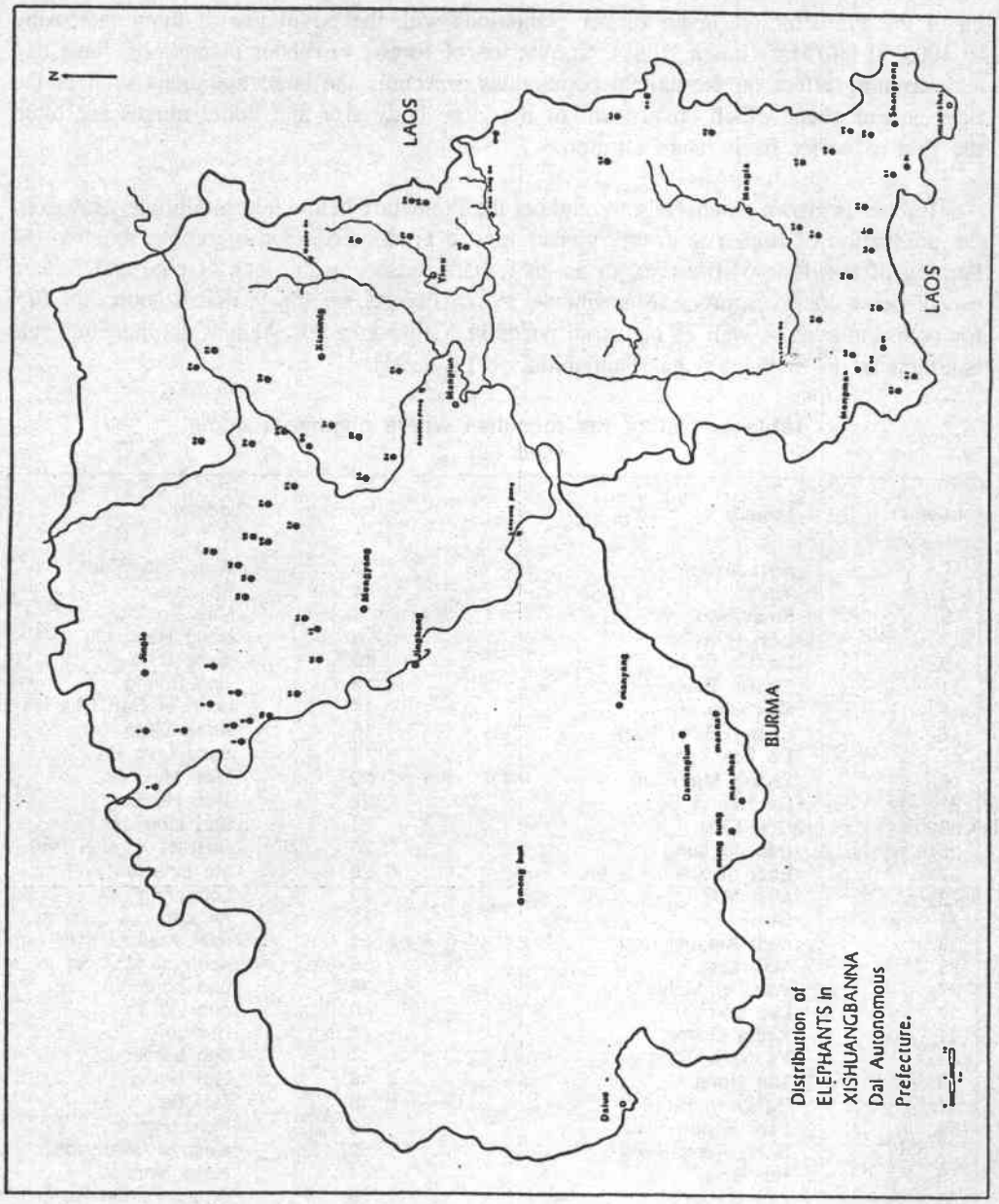


Fig. 2 Localities where elephants are reliably known to occur in Xishuangbanna Dai Autonomous Prefecture. (The numbers refer to the localities listed in Table 1).

Elephant Distribution

The principal finding is that elephants do not occur west of the Lancang (= Mekong) river in Xishuangbanna. There is one record of a single animal seen on the western bank of Lancang river in the north but this animal must have temporarily moved out of Mengyang reserve during the dry season. They are also mostly absent between the Nan Xing river south of Menglun reserve and Lan Na river just north of Shangyong reserve, except in a patch of forest along the border with Laos in the Mengla reserve (localities 41-45 in Figs. 2 & 3).

Another observation is that contrary to what was supposed in the past, there are no elephants along the border with Burma. All along the survey route from Manyang in the south-west along the border with Burma, the hills have been cleared of forests and a system of shifting cultivation appears to be the main form of land use by the hill tribes in the area. Elephants must have been extirpated along the Burma border over 30 years ago. We visited Damenlung, Ma Na, Man Shan and Meng Sung along the Burma border but there were no reports of elephants en route. Rubber plantations were extensive. Only at Man Shan was there a tract of undisturbed forest but even here there were no reports of elephants, although bears and gaur were reported to be plentiful.

The second part of the survey was carried out east of the Lancang river and along the border with Laos. Distribution of elephants was plotted on maps with the scale of 1:200,000 and 1:250,000.

Elephants occur in high and low densities across the survey areas. There are three areas of relatively high elephant density (about 0.12 to 0.49 per km2), they are: (1) Mengyang Nature Reserve in the north, (2) Shangyong Nature Reserve in the Southeast and (3) the area along the Xiaohei river from Menglun in the south to the north-eastern corner of Mengyang (Fig. 3). Other areas depicted in Fig. 3 represent those areas where elephants are either seasonal migrants from neighbouring Laos or areas of resident populations of elephants occurring in low densities.

It appears from Fig. 3 that the elephants in Xishuangbanna are distributed possibly in four large but discontinuous blocks. Mengyang Nature Reserve with an area of 99,733 ha supports about 100-120 elephants. The southern reserve of Shangyong with an area of 30,533 ha is known to be even richer in elephants and other large mammals such as the Gaur *(Bos gaurus)*. Given the mixture of forests, bamboo and grasslands available in this area (Fig. 4), Shangyong is likely to support a larger elephant population (between 130-150 animals) despite its smaller size. Along the Xiaohei river, the riparian forests are known to support an equally high population of about 100 animals seasonally. Mengla although large (92,933 ha) does not support a high density of elephants. The animals are restricted to the montane forests along the border with Laos up to an altitude of 1,400 m or more.

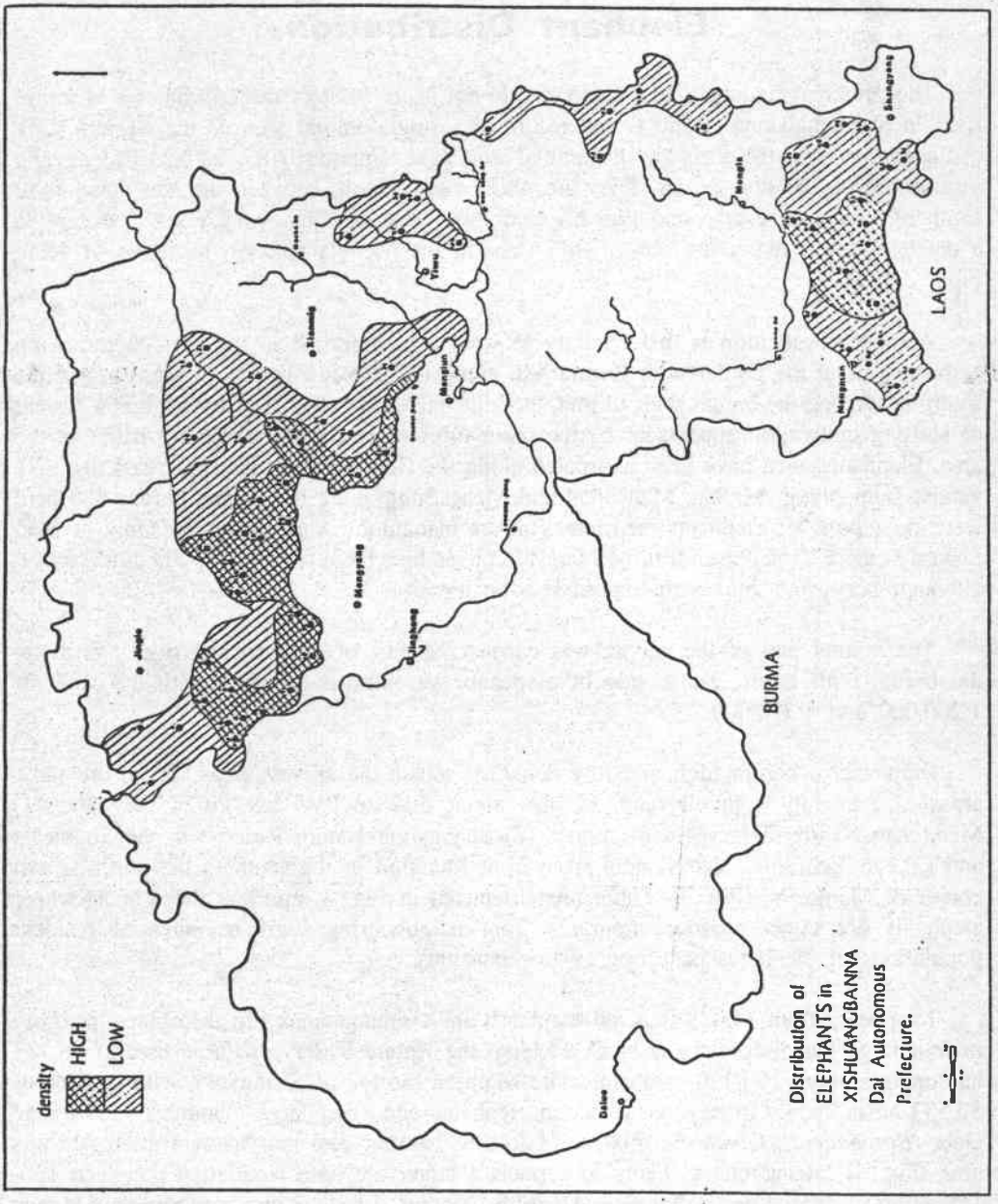


Fig. 3 Distribution of elephants in Xishuangbanna Prefecture. Shaded areas represent the maximum extent of the elephant populations, while cross hatched areas denote areas of relatively high elephant densities.

Food resources

The elephant population in Xishuangbanna ranges from 400 m along the Lancang river valleys to over 1,400 m along the border areas with Laos in the east. The altitudinal range of the mountains of Xishuangbanna is that most of the area is rich habitat for the elephant in the undisturbed stage. There are food resources available to the elephant at all levels. The bulk of the food of the elephant consists of bamboo which is plentiful throughout the Prefecture (Fig. 4). Among the most preferred food items are the bamboo *Dendrocalamus strictus* and wild sugar cane *Saccharum sinensis* which grow in abundance (Santiapillai & Li, 1990). However, in the vicinity of elephant ranges, farmers report crop losses through depredations by the elephant, wild pig and gaur. Elephants are a constant menace to farmers cultivating such palatable food items as sugar cane, corn and rice. The village of Ma Ling Si (No: 28) north-west of Xianmig suffers yearly crop depredations by elephants.

Fig. 4 represents the extent of the forest and bamboo within the known range of the elephant population. Elephants are rather plentiful in the western part of Mengyang reserve given the abundance of bamboo in this area. The south-eastern part of Mengyang consists mostly of secondary forest and it too provides optimum habitat for the elephants. Further down in the Shanyong reserve, a combination of forests, bamboo and grasslands enable the smaller reserve to support a much larger population.

The problem of dotted human settlements with their agricultural plots throughout the reserves provides another serious conservation problem vis-a-vis the elephant. Mengyang reserve is inhabited by about 40 villages where about 1,200 people live. Their farms are often raided by elephants leading to substantial loss of revenue. In 1989 alone, 21 villages in Mengyang reserve suffered elephant depredations in which about 250,000 kg of field rice was lost (Santiapillai & Li, 1990). Resolving the conflicts between man and elephant is one of the principal concerns of the Forestry Bureau in Xishuangbanna.

Poaching

Given the importance of wildlife products in China's traditional medical practices, and the commercial value of the elephant's tusks, poaching was considered to be one of the serious threats facing the elephants in Xishuangbanna (Xu 1987). But within the past few years, the situation appears to have improved substantially with no recent reports of elephants being killed for their ivory or gall bladder. This is all the more surprising given the easy availability of home-made firearms and guns. Poaching of elephants for ivory needs the co-operative efforts of a number of people and once an elephant is killed and tusks removed, it would be difficult to stop the news from reaching the village chiefs and other authorities through the "bush telephone" This is perhaps the main reason why there is hardly any poaching of the tuskers in Xishuangbanna.

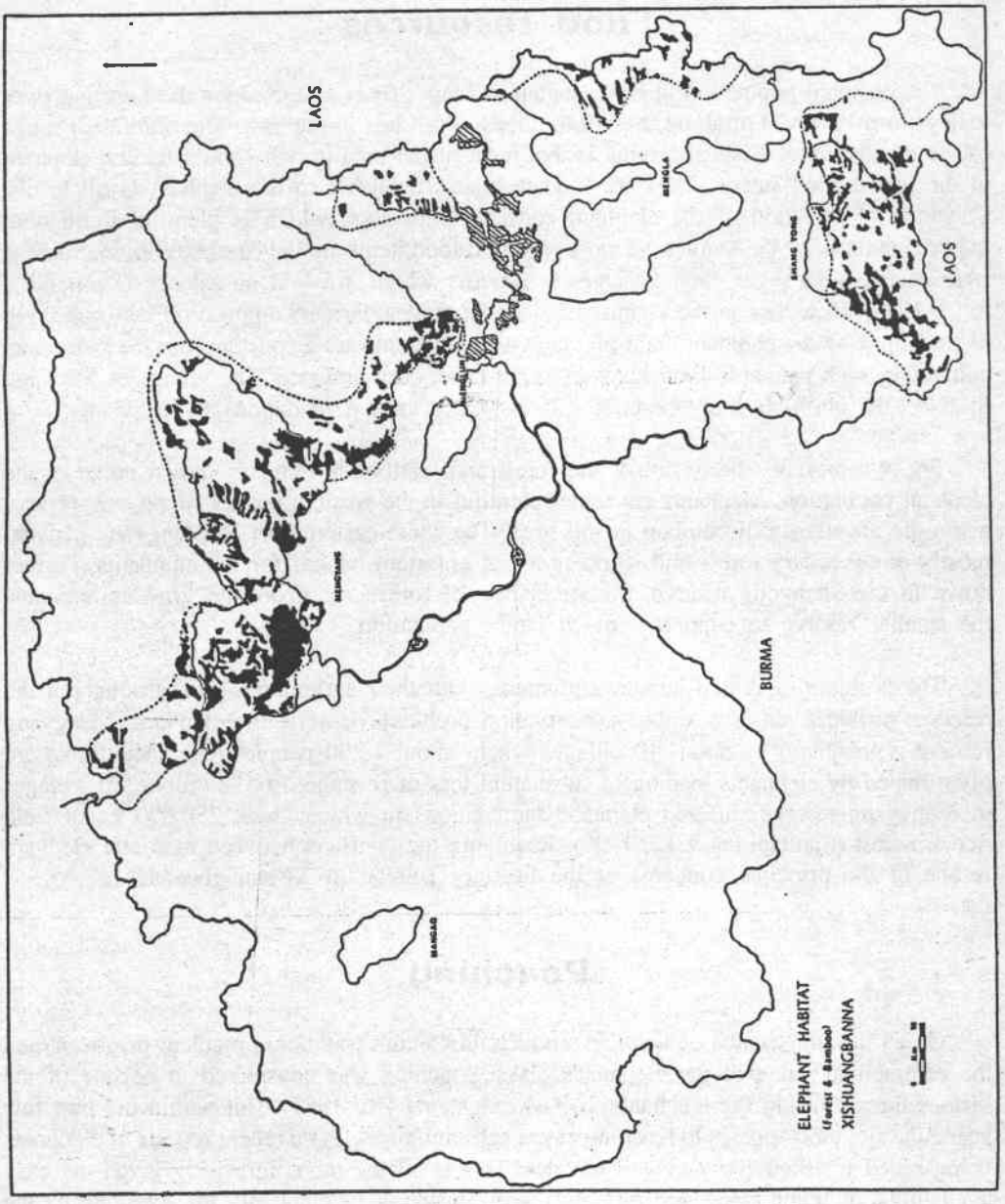


Fig. 4 The extent of forest and bamboo habitat (shaded black) available to the elephant within the known range in Xishuangbanna. The hatched areas represnt forest blocks that could form a corrdor to facilitate the free movement of elephants from Mengyang reserve to the Laotlan border and back.

Conclusion

Elephants occur in four of the five protected areas namely, Mengyang, Menglun, Mengla and Shanyong. They are absent in the Mangao reserve west of Lancang river. About 300 animals are estimated to occur in Xishuangbanna. The situation in Yunnan province has reached a critical stage. In the past 30 years, 50% of the forests have disappeared and the remainder is fragmented (Zu, 1987). Elephant populations are small, scattered and confined to areas surrounded by human settlements. Although 250,000 ha of forests have been set aside in Southern Yunnan for Conservation of elephant, the secondary vegetation which provides the major source of food for the animals, is not well represented within the area; furthermore the whole area is surrounded by croplands, rubber plantations and human settlements (Zu, 1987) leading to constant conflicts between man and elephant.

The long term prospects for the population of elephants in Xishuangbanna will depend on the degree of protection given to their habitat and on how successful the Forestry Bureau is in resolving the human-elephant conflicts in the area. Over large areas of Xishuangbanna, there is no longer adequate room for elephants to move about and adjust their densities to changing vegetation patterns. Their ranges are being compressed year by year as a result of human population growth and the demand for even larger areas for agriculture. The expanding human population is essentially being maintained by a subsistence economy. The changes in the land-use patterns are therefore resulting in the continuous contraction of elephant range. This serves also to cut off certain channels of response such as emigration and dispersion (Watson & Bell, 1969). The animals have lost so much of their original habitat to man in Xishuangbanna that emigration can no longer be considered a mechanism for regulating the population size. One way of overcoming this dilemma would be to establish forest corridors if possible to link contiguous elephant populations to allow for emigration, dispersion and inter-breeding. Fig. 4 illustrates one such possibility where the Mengyang population could be linked to the small population that occurs along the Laotian border through the establishment of a forest corridor - if such a feat is indeed possible. If such bolt-holes are not available to the elephants in Xishuangbanna, they may seek refuge in one or two of the protected areas such as Mengyang and Shangyong, thereby increasing their densities within these areas. The concentration of elephants in this manner into limited areas could lead to a build up in their densities even though absolute population size may be on the decline (Laws, 1981).

Another consideration for mangers must be the long-term viability of small populations of elephants. In general, the smaller the population size, the greater is its vulnerability to demographic, environmental and genetic sotochasticity (Shaffer, 1981; Gilpin & Soule, 1986). For long-term viability an effective population size of 500 has been suggested (Franklin, 1980; Frankel & Soule, 1981). However, not all small populations are *ipso facto* doomed. Although the effects of inbreeding depression are real they are also transitory. They are minimised if numbers recover quickly from bottlenecks. The population of 40± wild cattle at Chillingham in England after 800 years (about 120 generations) of continuous

inbreeding are fit and thriving (Whitehead, 1953). In the case of the elephants, given their longevity and longer generation interval, it would take much longer for any inbreeding to reach any appreciably deleterious level. A population of long lived elephants would require a very small genetically effective population size (Ne), while a short-lived species such as a field mouse may require a large one to preserve 90% heterozygosity after 200 years. The only long-term hope for the elephants in Xishuangbanna therefore rests on the effective protection that can be accorded at present to the four separate populations identified in the survey.

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