

## RESEARCH REPORT

### Report on the Distribution, Population, and Ecology of the Yunnan Snub-nosed Monkey (*Rhinopithecus bieti*)

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**ABSTRACT.** The Yunnan snub-nosed monkey (*Rhinopithecus bieti*), an endangered species in China, has received more protection in theory than in practice. Therefore it is on the very verge of extinction. The population of the species was estimated less than 2,000 individuals spread in 19 distinct groups. It was confirmed that the monkey was confined to the Yunling Mountain System, the area between the Yangtze River (Changjiang, aka Jinshajiang) to the east and the Mekong River (Lancangjiang) to the west. We further concluded that a lowland belt to the east, about 100 km long and 20–30 km wide was not suitable habitat for the monkeys, and appeared to serve as the natural ecogeologic barrier for the species. Our results indicated that the southern limit of the distribution was at Longma (26°14'N), and that the northern limit of the distribution was at Xiaochangdu (29°20'N). The distribution area of the species was substantially smaller than previously estimated. There were substantial ecological differences between the southern and northern parts of the species range. The monkey was found only in fir-larch forest.

**Key Words:** *Rhinopithecus*; Distribution; Population; Ecology; Conservation.

## INTRODUCTION

The Yunnan snub-nosed monkey (Colobinae: *Rhinopithecus bieti*), endemic to the People's Republic of China, is unquestionably one of the most endangered primates in the Old World, and also ranks high on the list of the world's most endangered mammals (IUCN, 1988). The Chinese government has designated the species in the first class of protected animals since 1977. However, conservation action has been limited by poor understanding of the monkey's ecology and distribution.

The monkey is the only non-human primate occurring in coniferous, montane forests at high elevations. The rugged habitat and extreme seasonality seem to have been prime forces in the evolution of the monkey's uncommon morphological and behavioral adaptations. The Yunnan snub-nosed monkey is larger than most colobines in body size, more terrestrial, and found in larger groups. Recent observations at Wuyapuya site (6 in Fig. 1), for example, indicated that adults might spend 35% of their time on the ground (KIRKPATRICK & LONG, unpubl.), and that group size can go up to near 200 individuals (WU et al., 1988).

The species has been known to science for about 100 years. French scientists secured the first seven specimens in the 1890s on the left bank of the Mekong in northwestern Yunnan (ELLIOT, 1913; ALLEN, 1938).

It has always been clear that the Yunnan snub-nosed monkey has a restricted range. ALLEN (1938) used the reports of collectors and a general knowledge of southwestern China's flora and fauna to speculate that the species was confined north to south between 27°00' and 29°30'N, and east to west between 98°40' and 99°30'E, a distribution approximately 400 km in length and 100 km in width. ALLEN thought the species would be found on both sides of the Yangtze River, although collectors had reported the monkey only to the west of the Yangtze. More recent estimates of distribution have been based on the reports of local officials and villagers throughout the monkey's range. LI et al. (1981) used such reports to argue that the distribution of the monkeys was confined by the Yangtze River in the east, and the Mekong River in the west, between 26°30'N and 31°00'N south to north. BAI et al. (1988) later argued that the range was somewhat smaller, being confined south to north between 26°31'N and 30°00'N. [LI et al.'s actual field survey was restricted to the Adong site (5 in Fig. 1), and BAI et al.'s actual field survey was restricted to the Baima Mountain area (6, 7, 8, 9, 10, and 11 in Fig. 1).]

Previous studies, however, have not addressed several critical issues: (1) the precise limits to the range of the Yunnan snub-nosed monkey; (2) distribution of the monkey within the overall range; (3) variation of ecology and behavior over the range; and (4) an estimate of population size based on systematic data. We here present initial results of a continuing survey aimed at addressing these issues.

## MATERIALS AND METHODS

A detailed study was made of each natural group discovered by our surveys. Surveys were conducted by LONG, ZHONGTAI, and XIAOLIN from October 1987 to December 1992. KIRKPATRICK joined surveys from September to November 1989 and from May to June 1992.

Initial decisions on survey locations were made on the basis of the literature and the reports of local hunters and officials. In the course of preliminary surveys, local villagers and officials also recommended additional sites that might hold monkey groups. If local people gave an accurate description of the species, or were in possession of the skins or skeletons of the monkey, a survey was conducted in the area. Preliminary results indicated that the Yunnan snub-nosed monkey might be associated solely with fir-larch forest. The association became obvious as the survey progressed, we therefore paid more attention to this forest type, and at times determining our survey sites by examining maps indicating vegetation types.

This is more effective than random transects for this species because: (1) groups are extremely rare and the possibility of meeting the groups with transect method is almost zero; (2) the distribution is fragmented into isolated populations and in each site only one group was found; (3) suitable habitat remains only in patches of alpine coniferous forest and the total area of such habitat is small; and (4) the determination of the actual location and size of all monkey groups was feasible through detailed study.

Between 21 and 55 days were spent in the field at each survey site. Existing trails were used as "transect lines," and all the trails in the area were travelled repeatedly (approximately 20 km per survey day). The presence or absence of monkey scat and other monkey signs (e.g. broken branches, discarded food items, etc.) were used as a parameter to estimate the ranging area and the population size of the monkey group. In some sites, all suitable habitat (i.e. area not in cultivation, not above the tree line) at the place was estimated as the home range of the group. These areas were then measured on topographical maps.

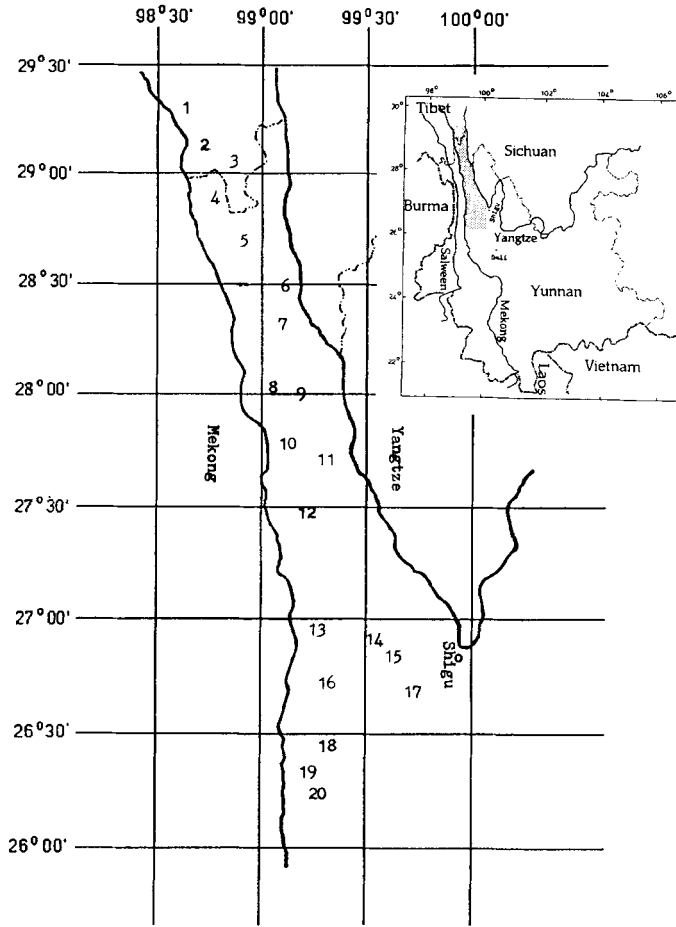


Fig. 1. The locations of the 20 natural groups of the Yunnan snub-nosed monkey (scale 1:4,160,000).

1:100,000 maps were used for the Xiaochangdu (1 in Fig. 1), Milaka (2 in Fig. 1), Bajia (3 in Fig. 1), Wuyapuya (6 in Fig. 1), and Yiyong (7 in Fig. 1) sites; 1:50,000 maps were used elsewhere.

When encountered, the monkey groups were observed for as long as possible (15 min – 10 hr), and relocated when possible on the next day. Counting of individuals in the monkey groups was difficult, and often impossible. This was due to the large size and dispersion of the groups, the density of the forest canopy and underbrush, the complexity of the topography, and the fact that all monkey groups were hunter-shy. On three occasions, however, actual counts of the group as it passed open areas in an irregular column were used to estimate total group size (Xiaochangdu, Bamei, and Wuyapuya sites). At other survey sites, the estimate was based on observations during brief encounters with the group and on the traces left by the group (scat cumulation, broken branches, discarded remnants of foods, etc.).

At the Longma site (20 in Fig. 1), the southernmost site, and the Xiaochangdu, the northernmost site, four 500-m vertical transects (placed at 100-m elevation increments) were laid and, for each tree species within each transect, the number of individual trees with diameters at breast height greater than 15 cm was recorded. The elevations of transects

in Longma were 3,100, 3,200, 3,300, and 3,400 m and those in Xiaochangdu were 3,900, 4,000, 4,100, and 4,200 m.

To illustrate graphically the structure of the habitat, at the Jinsichang site (14 in Fig. 1), four 50-m vegetation profiles (placed at 100-m elevation increments) were collected along a ridge frequented by the monkeys.

The data for estimated areas mentioned in the paper were obtained by measuring those patches in the maps with computer. Data of the human population were available for each village, and were based on the national population census of 1990.

## RESULTS

### DISTRIBUTION AND POPULATIONS

We found physical evidence of 20 groups of Yunnan snub-nosed monkey (see Table 1, Fig. 1), distributed irregularly within the range. Visual contact was made with only 10 of the 20 groups. Eleven of the groups had been reported previously, but 5 of the 11 were only known from second-hand reports.

During our surveys, villagers on the eastern side of the Yangtze and on the western side of the Mekong never reported having seen the monkeys. We believed that if the monkey existed on the eastern side of the Yangtze and the western side of the Mekong, the local people should know of the monkey, at least historically. Each of the monkey groups detailed in this report was well known to the local people. Therefore, the species must be confined to the narrow band between the Yangtze and Mekong Rivers.

The north-south range is more restricted than that previously reported. The northernmost group of the monkeys is located in Xiaochangdu (98°37'E, 29°20'N; 1 in Fig. 1), and the southernmost group is located at Longma (99°15'E, 26°14'N; 20 in Fig. 1). Therefore, the distribution area of the species is about one-third less than that estimated by LI et al. (1981).

**Table 1.** The locations of the 20 natural groups of the Yunnan snub-nosed monkey.

No.	Site	Latitude	Longitude	Population	Elevation (m)	Survey dates
1	Xiaochangdu	29°20'N	98°37'E	>200	3800-4300	Oct. 1988
2	Milaka	29°06'N	98°45'E	<100	3700-4200	May 1991
3	Bajia	29°02'N	98°52'E	<100	3700-4300	Jun. 1991
4	Bamei	28°54'N	98°46'E	<50	3700-4300	Oct. 1987
5	Adong	28°43'N	98°55'E	<50	3600-4200	Jul. 1991
6	Wuyapuya	28°29'N	99°06'E	>200	3500-4400	Nov. 1990, May & Jun. 1992
7	Yiyong	28°20'N	99°07'E	<50	3400-4200	Oct. 1990
8	Cikatong	28°02'N	99°03'E	<100	3200-3800	Jun. 1991
9	Guyoulong	27°58'N	99°03'E	<50	3700-4200	Jul. 1989
10	Shiba	27°46'N	99°07'E	<100	3300-4000	Aug. 1989
11	Guomorong	27°40'N	99°15'E	<100	3300-3800	Aug. 1991
12	Akou	27°27'N	99°11'E	<100	3400-3800	Nov. 1987
13	Houziqin	26°56'N	99°17'E	<50	3100-3500	Sept. 1990
14	Jinsichang	26°52'N	99°34'E	<150	3300-4000	Mar. & Apr. 1989
15	Moziping	26°48'N	99°36'E	<50	3200-3600	May 1989
16	Heishan	26°42'N	99°19'E	<50	3100-3600	Dec. 1990
17	Dapingzi	26°40'N	99°41'E	<50	3200-3900	Aug. 1989
18	Neidaqin	26°26'N	99°21'E	<100	3000-3400	Apr. 1992
19	Lashashan	26°20'N	99°14'E	<50	3200-3700	Jun. 1988
20	Longma	26°14'N	99°15'E	<50	3000-3500	May 1988

The raw distribution area of the species is about 16,500 km<sup>2</sup>, and comprises one county in Tibet (Mangkang) and four counties in Yunnan (Deqin, Weixi, Lijiang, and Lanping). The actual area of habitat available for the species is about 2,000 km<sup>2</sup>.

Estimated group size ranged from 50 to 200 individuals (see Table 1). The actual count at Xiaochangdu was 178, but we were certain some individuals might be missed in the counting procedure; the group was likely to be over 200 individuals. In Bamei, we counted 41, and estimated the group size at 50. At Wuyapuya, the count was made in this way: the group, while disturbed by human activities, split into three parallel lines; we chose the middle line, counted 91 animals, and estimate the entire group to be over 200.

ECOLOGY

The climate varies over the range. It is warmer and wetter in the south, and colder and drier in the north. In Lanping the yearly average temperature was 13.2°C and the rainfall 1,015.5 mm, whereas in Mangkang the average temperature 3.5°C and the rainfall 536.5 mm. At each site, local elevation differences sometimes span more than 3,000 m. As the elevation increases, the precipitation increases and the temperature drops rapidly.

All monkey groups recorded were in fir-larch forest. The monkeys clearly co-exist with this type of forest. Sometimes they also go to other types of forest such as pine forest and open areas nearby, but they mostly stay in fir-larch forest.

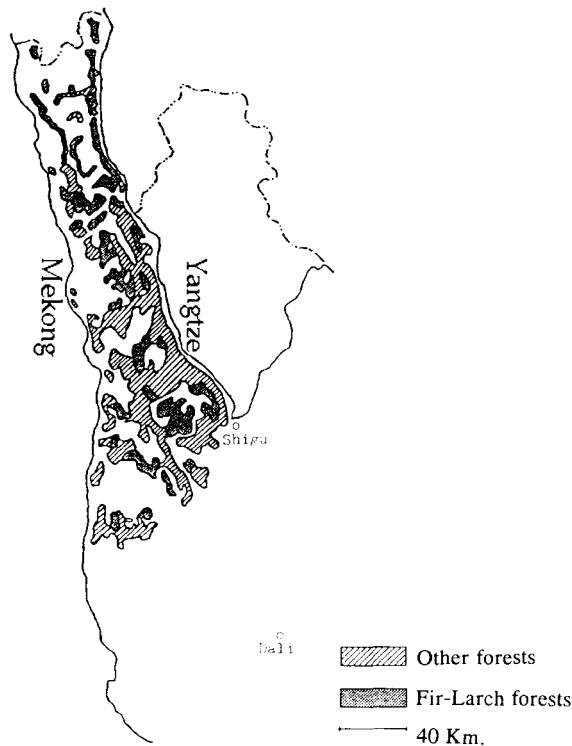


Fig. 2. The forest distribution map in the distribution area of the Yunnan snub-nosed monkey in Yunnan (Wu et al., 1987).

**Table 2.** Number of trees over 15 cm dbh in 500 × 10 m strips at Longma and Xiaochangdu.

Elevation of transect	Longma (m)				Xiaochangdu (m)			
	3100	3200	3300	3400	3900	4000	4100	4200
<b>Conifers</b>								
<i>Abies georgei</i> ORR	1	5	107	132	342	429	421	181
<i>Larix potaninii</i> BATALIN		14	47	38	85	34	57	36
<i>Pinus armandii</i> FRANCH.		1	19	1				
<i>Sabina squamata</i> ANTOINE			10	13	19	22	43	20
<i>Torreya yunnanensis</i> CHENG & FU	68	12	4	2				
<i>Tsuga forrestii</i> DOWNIE		7						
<b>Evergreen broadleaf</b>								
<i>Lithocarpus hypoglauca</i> HUANG	2	12	16	19				
<i>Quercus pannosa</i> HAND.-MAZZ.				116	61	36	110	217
<i>Rhododendron</i> spp. L.	17	146	226	312	50	213	174	290
<b>Deciduous broadleaf</b>								
<i>Acanthopanax cissifolius</i> HARMS		11	6	12				
<i>Acer caesium</i> WALL., EX BRANDIS	17	132	19	8				
<i>Betula</i> spp. L.		18	31	2				
<i>Lyonia villosa</i> HAND.-MAZZ.			1	64				
<i>Meliosma</i> spp. BL.	4	6	45	58				
<i>Populus adenopoda</i> MAXIM.		2	2	17				
<i>Salix cathayana</i> DIELS			5	1				
<b>Tree-like shrubs</b>								
<i>Enkianthus deflexus</i> SCHNEIDER	3			1				
<i>Euonymus</i> spp. L.			1	6				
<i>Hydrangea xanthoneu</i> DIELS	1	2						
<i>Ilex yunnanensis</i> FRANCH.	2	1						
<i>Ilex delavayi</i> FRANCH.			1	22				
<i>Photinia</i> spp. LINDL.	4	1	4					
<i>Pieris formosa</i> D. DON	7	3						
<i>Sorbus thibetica</i> HAND.-MAZZ.		20	2	2				

The total area of fir-larch forest within the raw distribution area was about 3,000 km<sup>2</sup> and divided into 31 patches like “islands” along the Yunling Mountains (Fig. 2; refer to WU et al., 1987). Thus, the monkey populations are confined to the forest fragments, and each group reported here appeared to be an isolated breeding population.

Within the “fir-larch forest type,” there are substantial local variations (Table 2). The forests in the southern region (typified by the Longma site) are quite complex compared with the forests in the northern region (typified by the Xiaochangdu site). Only the five core species of the fir-larch forest type were recorded in the transects at Xiaochangdu, while 19 additional species of trees or tree-like shrubs were recorded in the transects at Longma. Vegetation profiles of the lower elevations at the Jinsichang site (14 in Fig. 1; 3,400 and 3,500 m, Fig. 3) provide a good model for the structure of the forests in the south with “high diversity,” while higher elevations (3,600 and 3,700 m, Fig. 3) provide a good model for the forests in the north with “low diversity.” Scat findings indicated that the monkeys prefer lower elevations.

Home ranges appeared to be very wide. Some of them were over 40 km<sup>2</sup>. Both of the group size and home range seemed to be smaller in the south and larger in the north.

The elevation and width of fir-larch forest belt appeared to dictate the elevational range used by individual groups. Both the mountain and forest distribution are higher in the north, and the elevation at which groups are found becomes higher in the north.

Over the entire range, the species was found between the elevations of 3,000 and

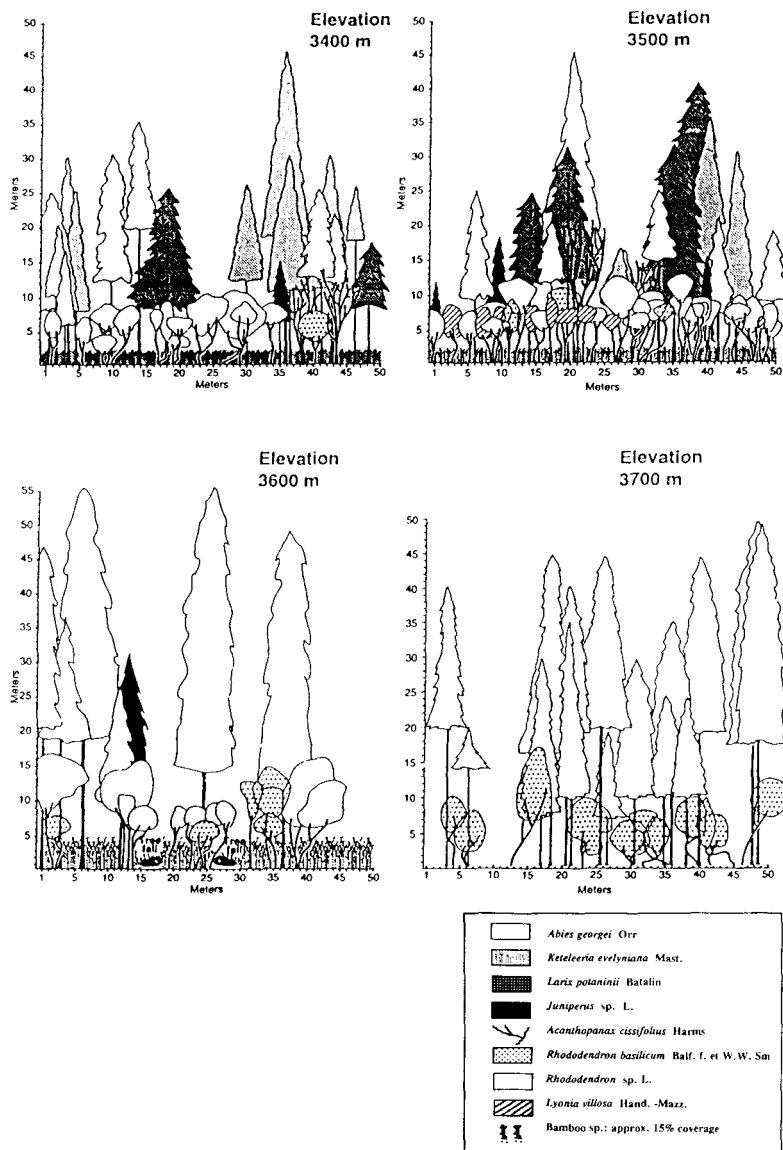


Fig. 3. Vegetation profiles at four elevations in Jinsichang site.

4,300 m. However, once at Wuyapuya, the monkey group was observed ranging at 4,700 m, far above the forest line, for several hours.

#### HUMAN IMPACT ON THE DISTRIBUTION OF THE MONKEYS

At individual sites, monkey groups typically range in an elevation band between 400–800 m — a range typically bounded by human disturbance at the lower end, and the tree line at the higher end.

Hunting is the greatest threat to the monkey. Throughout the range of the monkey, the

local people hunt the monkey for meat, leather, and the skeletons thought to possess medicinal properties. Killing of the Yunnan snub-nosed monkey and other wildlife has become worse since the 1960's when factory-made guns became available. Improved weapons have led to periodic slaughter of monkeys. In 1986, at Longma site (20 in Fig. 1), 36 monkeys were killed in one day by a large hunting party. At Moziping (15 in Fig. 1) in 1985, 32 monkeys were killed in one day. Mass killings do not occur every year, but a single mass killing could destroy a whole group.

Deforestation is another threat to the species. Within Yunnan Province, in which over 80 percent of the Yunnan snub-nosed monkey population is found, there is about 3,000 km<sup>2</sup> of fir-larch forest between the Yangtze and Mekong (Fig. 2). Much of this forest is targeted for logging by local forestry departments. Each year, about 200,000 m<sup>3</sup> of commercial logs are removed from the area. Harvesting of fire-wood is also a major impact on the forest. The number of human inhabitants within the raw distribution area was estimated at 331,600. If one person uses 10 kg of wood each day for fuel, and one cubic meter of wood weighs 1,000 kg (usually less than that), then the 330,000 inhabitants of the region will use over 1,500,000 m<sup>3</sup> of wood each year. Moreover, the local people need the wood for building material, and shifting cultivation is still employed by some people (e.g. the Yi ethnic group).

## DISCUSSION

### DISTRIBUTION

In the monkey distribution region, the Yangtze is at 1,800 to 2,200 m in elevation, and the Mekong 1,500 to 2,400 m, substantially below the lowest elevation at which the species has been recorded. Even in these upper reaches, these rivers are strong and wide. The Yangtze and Mekong are likely to act as biogeographic barriers to species distribution. The Yangtze does, however, turn eastward at Shigu (see Fig. 1); although there is suitable habitat, no evidence of the monkey has been found for the area east of Shigu (contra YANG, 1988). Extending south from Shigu to Dali (Fig. 1), there is a 20–30 km wide zone that does not rise above 3,000 m, and contains no fir-larch forest. This seems to be a biogeographic barrier to the species.

A report by WOOD (in ALI, 1953, see also GEE, 1952) suggests a western limit to the snub-nosed monkey distribution in Assam. Since the Yunnan snub-nosed monkey occurs further west than any other member of the genus *Rhinopithecus* (TAN, 1985), WOOD's report potentially refers to the Yunnan snub-nosed monkey. WOOD's sightings were at Manipur (approx. 24°N, 94°E) and in the Cossya Hills (approx. 25°30'N, 92°E). Our survey strongly suggest that the Mekong River is a biogeographic barrier to monkey distribution, and therefore we believe that WOOD's sightings were not of snub-nosed monkeys. Between the Yunling Mountains and Assam lies not only the Mekong, but the Salween and the Irrawaddy as well.

There is only one patch of this fir-larch forest type to the south of Longma (WU et al., 1987) and there is no record of monkeys in these forests (in the Chang Mountains, adjacently to Erhai Lake). The fertile soil of the Erhai Basin has resulted in a concentration of human population since the Han Dynasty (206 B.C. to 200 A.D.). It is possible that the Chang Mountains once held the monkeys, but they became extinct long ago.

The northern limit of the distribution of the monkey is likely to be at Xiaochangdu (29°20'N). To the north of the site, there are at least two large tracts of fir-larch forest



which might contain monkeys. In fact, the forest area between Mangkang (29°40'N) and Batang (30°00'N) apparently held monkeys in the late 1800's (Prince D'Orleans, in ALLEN, 1938). However, in our survey, one fur trader (a Tibetan in Mangkang) reported that skins of the monkeys were not available so far north. Although the areas north of Xiaochangdu warrant further investigation, we tentatively place the northern limit of the species at the site because no physical evidence available demonstrates the existence of the species north of this site.

#### ECOLOGY

This study suggests that the Yunnan snub-nosed monkey is closely associated with fir-larch forest. The reasons for this association are unclear. Conifer trees do not form a major part of the diet (ZHAO et al., 1988; WU & HE, 1989), although the monkeys may feed on other plants (such as lichen and moss) that are associated with the fir-larch forest type. Fir and larch are the largest trees in this region, and these trees may be the most convenient for travel, and may provide the best concealment from hunters and predators.

As the Yunling Mountains rise from south to north, so too do the forest belts. The forests at Longma, for example, begin at 3,000 m, with the tree line is at 3,500 m. In comparison, the forests at Xiaochangdu begin at 3,700 m and the tree line is at 4,200 m. These elevation differences are responsible, in part, for habitat differences between the northern and southern regions of the distribution of the monkey (Table 2, refer also to Fig. 2). The southern forests have a greater diversity of trees, including a larger proportion of broad-leaf trees.

We saw monkey sometimes staying in the open for several hours and it is possible that the monkeys may be able to survive amidst deforestation (also refer to ZHAO et al., 1988). With such a large and predatory human population around the forest, however, groups of the animals living outside the forest would be doomed.

#### CONSERVATION STATUS

The Yunnan snub-nosed monkey has been under "first class protection," the highest level of protection for endangered species in China, since 1977. Unfortunately, the monkey has received more protection in theory than in practice. Hunting and logging continues, often with official complicity (TAN, 1985; ANONYMOUS, 1988).

Areas set up to protect the monkey are poorly planned and poorly managed. For example, the Tianchi Nature Reserve (about 50 km away from Longma site in the south), set aside expressly to protect the monkey, is in fact outside the range of the species. No snub-nosed monkey has ever been found in the reserve. Poor management is seen in the Yunnan Forest Department's response in 1987 to a moth larvae infestation in the forests at Yiyong (7 in Fig. 1). High levels of pesticide were sprayed over a large portion of the monkeys' range to control the moth infestation. Five monkey carcasses were found in the Yiyong area the next year (presumably poisoned by the pesticide), and the Yiyong monkey group has not been reported since the spraying. It is unlikely that the loss of the monkeys after pesticide spraying is coincidental.

The Yunnan snub-nosed monkey clearly faces extinction (EUDEY, 1987; IUCN, 1988). There are only 19 natural groups of the species left (the 20 groups reported in Table 1, minus the Yiyong group). The total population of the Yunnan snub-nosed monkey is less than 2,000. Of all the 19 groups, only four groups (6, 8, 9, and 10 in Fig. 1) are located in a

formal reserve (Baimaxueshan). Four groups are located in two informal reserves [Hongla (1, 2, and 3 in Fig. 1) & Jinsichang (14 in Fig. 1)]. More than half the groups received no protection at all.

In order to protect this precious species, we recommend the following conservation actions: (1) development and management of a system of nature reserve including all the 19 sites listed in Table 1; (2) a program of training for the workers involved in the conservation project; and (3) a program to ensure that local people understand the value of the monkey and its habitat, and to ensure that local people still can improve their living condition although the species is protect.

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