Preliminary Report

Snub-nosed Monkey Research and Conservation Project

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In summer 1999 six Cambridge University students teamed up with 5 students from China to investigate issues surrounding the conservation of the Yunnan Snub-nosed Monkey (*Rhinopithecus bieti*). The study was based in the village of Nanren, just outside the northern boundary of Baima Xueshan Nature Reserve, Deqin Prefecture, Yunnan Province, China.

Rhinopithecus (R.) bieti (Yunnan snub-nosed monkey, Allen, 1938) is one of the rarest and most endangered primates of the Old World (Hong Lan *et al.*, 1995). There are only about 1,500 individuals remaining (Long *et al.*, 1994; 1998) in 13 distinct groups (Zhong *et al.*, 1999) living solely in the temperate Himalayas of South-western China (Long *et al.*, 1994). The Chinese government has designated the species in the first class of protected animals since 1977 and it is classified as List1-endangered (IUCN, 1996). However, conservation action has been limited by poor understanding of the monkey's ecology and distribution (Long *et al.*, 1994).

The village of Nanren (南仁) (99°06'E, 28°35'N) lies at c. 3,300m above sea level in the Hengduan Mountains of North-western Yunnan Province, Peoples' Republic of China, just outside the northern boundaries of Baima Xueshan Nature Reserve (白马雪山). It lies about three hours by mountain path from Xincun (新村), which is on the Deqin–Yang La Highway. The village is alternatively accessible by a 12-hour walk over high mountain passes to Deqin. Nanren is a Tibetan settlement of 274 people in 42 households, living from crops grown in the drylands in the village, and in the irrigated wetland. They graze cattle in mountain pastures and collect cash crops such as mushrooms from the forest. The people from the village also use timber from the forest as firewood, building material and fertilizer.

This project combined three different areas of study, concentrating on the group of monkeys living in the forest around Nanren village (from here on referred to as the "Nanren group" – previously "Wuyapia group"):

- Monkey habitat use and population demographics:
  - A study of the ranging behaviour of the Nanren group during the period of study
  - Collection of information from local people about the annual ranging behaviour of the monkeys
  - A study of habitat suitability looking at distribution of major monkey foods
  - A study of the population size and demography based on opportunistic scans
- Forest distribution and history around the Nanren valley
- A Participatory Rural Appraisal of the resource use, interaction with the environment and development aspirations of the residents of Nanren village.

Chapter 1

Primate Ecology

Ranging Behaviour, Population Size and Group Composition of *R. bieti*

Introduction

Rhinopithecus (R.) bieti (Yunnan snub-nosed monkey, Allen, 1938) is one of the rarest and most endangered primates of the Old World (Hong Lan *et al.*, 1995). There are only about 1,500 individuals remaining (Long *et al., 19*94; 1998) in 13 distinct groups (Zhong *et* al. 1999) living solely in the temperate Himalayas of South-western China (Long *et al.*, 1994). The Chinese government has designated the species in the first class of protected animals since 1977 and it is classified as List1-endangered (IUCN, 1996). However, conservation action has been limited by poor understanding of the monkeys' ecology and distribution (Long *et al.*, 1994). The aim of this study was to ascertain correlations between the monkey's ranging behaviour, feeding ecology and human activity in the area.

R. bieti lives at high elevations in which snow is common. The severe climate and extreme ruggedness of their habitat have been prime forces in the evolution of the monkey's uncommon morphological, ecological and behavioural adaptations (Long *et al.,* 1998). Both the social organisation and the range use of *R. bieti* are closely tied to its uncommon food choice (Kirkpatrick *et al.*, 1998). The primary food choice of the study group of monkeys is lichens of *Bryoria* spp. (Kirkpatrick, 1996) supplemented with ground plants (Wu & He, 1989).

Methods

The study was carried out from 16th July – 30th August 1999 around Nanren valley, Deqin County, Yunnan Province, Peoples' Republic of China (99°06'E, 28°35'N). The study area covered Yongbao valley in the East to Sayong valley in the West, encompassing a gross area of approximately 55km^2. The 3 valleys in the study, primarily composed of fir forest, included the village of Nanren, which has a population of 274 people. The Nanren group of *R. bieti* previously resided around the village of Wuyapuya (99°12'E, 28°30'N). However, its home range has recently changed to the valleys around the village of Nanren and from here on the group will be referred to as the Nanren group.

Ranging behaviour

The monkeys were observed directly to study ranging behaviour between 08:00 and dusk (about 20:00). However, as contact time was short due to adverse weather conditions, indirect methods were also employed.

Direct observations

The monkeys were located based upon their position from the previous day and from information obtained from local people. They were then followed for as long as possible, and their position was marked on a 1:100,000 map at one-hour intervals, observation conditions permitting. When the monkeys could not be located visually, their position was estimated based upon sounds of activity, which included alarm calls and breaking branches.

Indirect methods

During transect work and the monkey tracking, monkey faeces, broken branches and evidence of monkey feeding were often encountered. A 1:100,000 map was divided into 1km squares and the position where these signs were sighted was marked. Information about the monkey group's location was also ascertained from local Tibetan herders and villagers who had either seen or heard the group.

As the study period was short in length, the ranging behaviour of *R. bieti* was determined by interviewing former hunters, mushroom collectors and forest experts from Nanren. They were asked to mark on a map where they worked within the three main valleys under study, whether they saw or heard the monkeys there, or whether monkey signs had been seen. The months of the Tibetan calendar when sightings occurred were noted, then areas of the valleys given a score of 1 to 5 depending on perceived relative importance to the monkeys, with 1 being least important, 5 most important, based on frequency of sightings.

Population Counts

When the monkeys had been located, their movement was followed using a 20-45x telescope (Nikon Fieldscope EDII) and 10x binoculars (Minolta Activa). Occasionally, the group crossed open areas, which provided the opportunity for population counts. During counts, the telescope was fixed upon one point in the monkeys' path to enable accurate recording. If the monkeys crossed using two paths a second observer carried out a count using binoculars, fixed on a point on the second path. If the monkeys used more than two paths, it was not possible to accurately assess the population size.

Group Demography and Behaviour

Group scans were taken at hourly intervals using a 20-45× telescope (Nikon Fieldscope EDII), typically from a rock outcrop. Scans proceeded from left to right, with all individuals in one tree scored before moving on. Data was collected on age (Table 1, below), sex (Table 1), distance to nearest neighbour, and whether the nearest neighbour was in the same tree. The monkeys' position was recorded as either terrestrial, crown of tree, middle of tree or bottom of tree. The monkey's activity was recorded as soon as possible, although up to 5 seconds were allowed for age/sex classification. Activity (Table 2, below) included feeding, travelling, social; grooming, play or other, resting and other.

Adult Male	Largest individual of troop (typically >1.5× the size of other individuals). Long white hair on flanks obscures ishial callosities, strong contrast of black and white hair. Hair on top of head falls forward, tail long and bushy. Perineal region with red stripe. White testicles contrast with black inner thighs. Rotund.
Adult Female	Large individuals. Short white hair on flanks, ishial callosities visible. Contrast of black/grey and white hair weaker than in males. Hair on top of head in a 'top-knot'. Tails gracile relative to males. Often with infants. Black nipples contrast white chest hair. Typically lithe.
Adult Male/Juvenile	Tail relatively hirsute compared to the tails of adult females, but unable to ascertain whether adult or juvenile.
Juvenile	Medium-sized individuals. Back and limbs light grey. Tail hair short. Play variable.
Yearling	Small individuals. Light grey. Much play. Agile in travel.
Infant	Smallest individuals. Bright white to about 2 months, gradually with light grey on back. Top of head with black stripe 6-8 months. Not agile in travel, carried by adult female.

- Table 1: Definition of Age/Sex classes (Kirkpatrick, 1996)

Feeding	Reaching for, handling or chewing food items (not including inactivity during feeding sessions).
Travelling	Moving the entire body (includes self play by infants).
Socialising	Active physical contact or mutual attention between 2 monkeys. Includes affiliative and agonistic behaviours: social grooming, social play and other social activities.
Resting	Apparent inactivity: not feeding, travelling or socialising (self grooming included under resting). Rest-huddle was defined as resting whilst encompassing another individual. Infants were not assigned to this category.
Other	Any activity not included in the above activities. Activity was stated.

- Table 2: Behaviour definitions (Kirkpatrick, 1996)

Results

Ranging Behaviour

The Nanren group was observed directly in Sayong, Nanren and Yongbao valleys (Appendix I). They were only observed in the North West side of Sayong valley and the South West side of Yongbao valley, but they were seen on both sides of Nanren valley. In 6 and a half weeks of observation, monkeys were directly observed in 12 of the 1km² map cells, and were indirectly observed in another 4 map cells, a total of 16km².

Group Size

The highest minimum count for the Nanren group is 252, recorded on 4th August 1999, when the group crossed a clearing, approximately 500m wide. This was observed using a 20 - 45x telescope (Nikon Fieldscope EDII), at a distance of approximately 700m. Although this is a large distance, the monkeys crossed a clearing about 500m wide in single file, and the telescope remained fixed on a single point in the monkeys path to enable an accurate count. However, no infants were included in this count, as they were not visible when being carried by females terrestrially. The true size of the Nanren group is therefore >250, but probably <290, assuming the average family size is 7, being composed of 1 adult male, 3 adult females, 1 juvenile, 1 yearling and 1 infant (Xiao Lin *pers. comm.*).

Group Demography and Behaviour

Overall 9 scans were obtained over 4 days, with a total of 86 individuals observed. However, 7 of the 9 scans were located at the same site and one of the other 2 scans was a sighting of male monkeys at the forest edge, which may lead to biased results.

During the scans it was noted whether the individual under observation was situated either; in the crown of the tree, middle of the tree, bottom of the tree or on the ground. Out of the 86 individuals, 51 (59%) were in the crown of the tree, 11 (13%) were in the middle of the tree, 1 (1%) was on the ground and 23 (27%) were unspecified.

All of the adult females, juveniles, yearlings and infants seen were in the crown of the tree. The adult males were either in the crown of the tree or the middle of the tree, as were the unidentified individuals. The adult females/juvenile males were mostly observed in the crown or middle of the tree, but one was observed on the ground. No monkeys were observed in the bottom of the tree.

The behaviour of each individual was noted. The majority of the monkeys observed were in the process of feeding. These results tended to be recorded late in the evening, between 16:00 and 19:00 whilst the monkeys were at the same location. Otherwise, the monkeys were mostly involved in skirmishes and an adult female plus an unsexed adult were observed resting. When juveniles were observed they were often engaged in the act of play.

The only individual who could be specifically identified during scans was an adult male with his left arm missing. He was on his own in a tree using his leg to pull down branches to eat. A yearling was with him, staying close to him for at least 10 minutes.

During all of the scans, only once was there more than one adult male in the same tree.

Discussion

Ranging Behaviour

As the study group was never followed for long without loosing contact, it was not feasible to calculate their ranging behaviour. Any results calculated would also be inaccurate, due the limited time scale of the project confounding with variation in ranging behaviour between seasons (Zhong *et al.* 1999). However, it was possible to note the 3 valleys that the monkeys are currently residing in, which when combined with the information gathered from local people provides an estimate of the monkeys home range.

Group Size

In 1994 the group's population was reported to be >175, but <200 *(*Kirkpatrick *et al., 19*98). The observations in 1999 show that there has been a large increase in the population. Groups of >100 individuals of *R. bieti* are well known (Bai *et al., 19*88; Wu 1993; Long *et al., 19*94; Kirkpatrick *et al., 19*98), which may be explained by Hamilton's (1971) selfish herd hypothesis (Kirkpatrick *et al.,* 1998).

Group Demography

Due to the limited contact time during the study, it was not possible to draw conclusions about group demography. Also, many of the scans occurred at the same location and one occurred at the forest edge, which may bias the data, with for example, more adult males being observed in exposed areas. Our data showed an unexpectedly high proportion of adult males (18) to adult females (11). All of the adult females were observed in the crown of the tree. This may have biased the data by undercounting the number of females situated in less visible positions, e.g. non were observed in the bottom of the tree, but this area often is difficult to see and therefore, individuals present here may not have been noted. As the majority of the scans observed the monkeys in the crown of trees, this supports the fact that adult males are usually seen in the crown of the trees (Xiao Lin *pers. comm.*).

It was noted though that the monkeys crossed clearings in family groups, with the adult male leading the family. Previous studies reported that the group was composed predominantly of one-male units (OMUs), which is particularly apparent when the group travelled above the tree line or crossed gullies terrestrially (Kirkpatrick *et al.*, 1998). The splitting of the group into OMUs is further supported by the fact that only once was there more than one adult male observed in the same tree.

At one point when the monkeys crossed a rock face, the first family was a group of 5 adult males, which composed a one all-male unit (AMU). The AMU's are typically located at the front or rear of the whole monkey group (Xiao Lin, *pers. comm.*), which is consistent with our observations. An AMU was reported by Kirkpatrick *et al.* (1998) consisting of a core of 2 males, (one of which was missing the right arm), and several juveniles. The AMU observed in this study did not contain any disabled monkeys, but an adult male with the left arm missing was observed and was accompanied by a yearling.

Group Behaviour

As the scans mainly occurred in the evening, this will bias the observed behaviour of the monkeys. The vast majority of the individuals in scans were feeding, which is consistent with the results of Long *et al.* (1998) where it was noted that feeding peaks occurred between 16:00 and 20:00. 7 out of the 9 scans occurred after 16:00, and all individuals in these scans were feeding.

Feeding and resting are the two most frequent activities for all age/sex classes, except infants (Long *et al.* 1998), which was also noted in this study. Highly visible activities such as feeding and moving were probably easier to detect and may have resulted in the monkey group being located more often during periods of these activities. Stationary activities, such as resting and grooming may have been less easy to detect and thus introduced biases into the data. For this reason and the limited contact time, it was not possible to calculate time budgets for the study group.

Feeding Behaviour And Habitat Use

Introduction

Both the social organisation and the range use of *R. bieti* are closely tied to its uncommon food choice (Kirkpatrick *et al.*, 1998). During the period of study, the forest types within and around the monkey's home range were characterised according to the density of the different food sources of the Nanren group of *R. bieti*. The primary food choice of the Nanren group of monkeys is lichens of *Bryoria* (Kirkpatrick, 1996) supplemented with ground plants (Wu & He, 1989). Other food types were identified through discussion with local residents and through previous research experience (Xiao Lin, *pers. com.*)

Methods

Food type identification

Initially, monkey food sources were identified and samples were collected through transect walks with a local field assistant. A 'seasonal calendar' was constructed in order to identify seasonality of the different food types within the monkeys' diet. This participatory tool used local knowledge through visually dividing the food amongst the twelve months of the year.

The foods were also ranked in terms of importance within the monkeys' diet, again using local knowledge and experience through previous studies of *R. bieti* (Xiao Lin, *pers. com.*).

Forest surveying techniques

To characterise the forest types in the Nanren area in terms of suitability as monkey habitat, 17 plots were made to quantify monkey food in Nanren, Sayong and Yongbao valleys. Plots were chosen by stratified random sampling within each forest type, at a random altitude and random distance across the forest. Plots were chosen so that all forest types were surveyed, with the largest number where the monkeys are known to be most active. Survey areas consisted of 30 x 30 m plots, divided into nine 10 x 10m blocks, the locations of which are marked on the map.

Within each block, shrubs of the species identified in the seasonal calendars were assigned percentage coverage categories (Coverage categories: <1%, 1-2%, 2-5%, 5-10%, 10-25%, 25-50%, 50-75%, 75-100%). Trees were defined as individuals with a girth greater than 3cm that were over 1.4m in height, saplings as individuals with a girth less than 3cm that have attained a height greater than 1.4m, and any individual smaller than this was defined as a seedling. Individuals of each category and species were counted for each 10×10m area. Logged stumps, fallen and dead trees were also counted under separate categories. *Rhododendron spp.* was classified as a shrub for the purposes of this survey. Some of the species identified on the seasonal calendar were not in season during the period of the study, and others, for example insects under bark or in yak dung, were too difficult to quantify. However in several cases, the location and relative abundances of these foodstuffs was described in the mapping exercise conducted. None of these foods were ranked highly in terms of importance to the monkeys, so omitting their inclusion should not lessen the validity of the study.

All trees within the plot, and the *Rhododendron* shrubs, were assigned to one of five lichen load categories. "None" meant no lichen was visible; "Sparse" meant less than 50% of the branches had coverage, and that this cover was limited; "Light" meant coverage on 50 to ~75% of branches; "Moderate" indicted ~75 to 100% of branches had cover, and lichen could extend to 10cm or more; "Heavy" meant cover on all branches, and lichen of 10cm length or more was common. Each of these categories was assigned a rank from 0 for "None" to 5 for "Dense", to provide an arbitrary scale to allow comparison between different plots. These assignments were made separately for the two species of lichen known to be monkey food, *Bryoria spp*. and *Usnea spp.*. In some cases the estimates may be somewhat biased, as the monkeys had recently been through that area of forest and eaten an unknown proportion of lichen, but as far as possible, it has been noted when this occurred.

Results from range map

Human influences on monkey ranging behaviour

According to the range map of Nanren, Sayong and Yongbao drawn by mushroom collectors and forest experts of Nanren, the current home range of the monkeys seems to be restricted to these three valley systems, with no sightings reported outside this area in the last year. There appears to be a strong correlation between seasonality of valley use by the monkeys and an absence of human activity in that area, with monkeys apparently using sites just before or just after peak human activity. The clearest example of this appears to be the shift in home range from Wuyapia in the south of Baima Xueshan Nature Reserve towards Nanren. The group with whom the mapping was conducted explained that this was because in the 1980s there was much hunting in Nanren, whilst the forest in Wuyapia was less disturbed. However, a ban on hunting in Nanren and concurrent rise in Song Rong mushroom collection in Wuyapia appears to have shifted the monkeys towards Nanren.

The forest in the slopes around Nanren valley were given the highest rank in terms of importance as monkey habitat, but human activity is high here from the third to seventh months of the Tibetan calendar, with monkeys using the area only in months seven and eight, then eleven to two, apparently avoiding the slopes when human activity is at a maximum, shifting to Yongbao valley as soon as tree felling begins in month three. Further evidence includes that when insect herb collection begins in Yongbao in the fifth month, and activity in Nanren valley is still high, the monkeys move to Sayong valley, and that the monkeys use the grazing lands only when the yaks and herders have moved back to the villages.

Monkey food abundance

Lichen

From the 17 plots conducted in the Nanren area, it appears that lichen abundance and species are dependent on forest type and altitude, with black *Bryoria spp.,* the main monkey food, constituting over 70% of their diet (Xiao Lin, *pers. comm.*), growing at higher elevations than the white lichen, *Usnea barbarta*. Lichen is most abundant in the upper slopes of Nanren valley and in the upper slopes of Xueshan, both of which are predominantly *Abies spp*. fir forests. *Larix spp*., appeared to support less lichen growth, with some species of *Pinus* apparently being unsuitable for lichen altogether. A very clear line was obvious where forest type changed from fir to steeple pine on Nanren east ridge, with a high lichen load in the fir and none in the pine. The amount of lichen found in each plot, even at the same elevations, was not constant and showed no correlation with slope facing bearing.

In many plots, lichen appeared to be capable of establishing on two-year-old stems that have undergone secondary thickening on seedlings, *Rhododendron spp.*, and other monkey food plants.

Even when plots were conducted in areas through which the monkeys had recently passed, the branches were not entirely stripped of lichen, although quantities found were somewhat less than would have been expected for that elevation. Often, lichen laden broken branches were found on the ground in the plots.

Non-Lichen Monkey Foods

Local differences in non-lichen foods eaten at different sites are documented (Kirkpatrick *et al.*1998), and those quantified in this study certainly do not constitute a comprehensive list, even for this area, as there are many plants that are eaten in small amounts. There appear to be foods that occur in Sayong valley, such as unidentified green shoots, which occur only there of the three valley systems, and some shrub species specifically growing by the river are eaten by the monkeys. This study looked at all the foods listed in the seasonal calendar, which are hopefully the major sources in this area.

Of the non-lichen monkey foods studied, Naro Poro was found to be the most abundant across all plots, although in no plots did percentage cover afforded by a single species exceed 30%. It appears that the monkeys' foods are most abundant in fir forest, and will not grow if the rhododendron cover is too dense. In the two plots conducted at the summit of Nanren east ridge, no non-lichen monkey foods were found, and in the larch forested areas, there were minimal amounts present. This study concluded no correlation of these

species with altitude or slope bearing. The greatest percentage cover of monkeys food species for a plot was found in Nanren main forest at higher altitudes where the forest is less disturbed by human activity.

Discussion

Across temperate living primates, factors such as wind chill human activity and seasonal avaliability of food species interact with temperatures to determine altitudinal choice. (Kirkpatrick and Long 1994).

The main food eaten by *Rhinopithecus bieti* (91% of feeding time) is *Bryoria spp.* (Kirkpatrick *et al.*1998), hence this is the main lichen of importance in this study. *Bryoria spp.* was found to grow predominantly at altitudes above 4,000m, where *Abies georgei* is the principal species, supporting the data gathered by Kirkpatrick *et al.* in Wuyapia (1996). It was found to be most abundant in the intact forest at the top of Nanren valley. At lower altitudes in forests of *Pinus spp., Quercus pannosa* and *Acer spp.,* white lichen *Usnea spp.* is more common, but tends to occur most abundantly on *Abies* at the lower end of its range. This agrees with the assumptions made by Kirkpatrick and Long in 1994 that *Abies spp*. has 50% of the *Bryoria* load at 3800m as compared to 4800m. Two forms of white lichen occur, pendulous and non-pendulous varieties, and there is some difference of opinion as to which is eaten. The pendulous species is much more common, with the shorter variety being found only in two plots of the seventeen done.

Both *Bryoria spp*. and *Usnea spp.* were found to grow on shrubs and seedlings in quite high abundance. It has previously been postulated that for lichen to regenerate in an area following habitation by monkeys takes over 20 years (Kirkpatrick *et al.*1996). However, it was found that even when monkeys had recently been through a forest area, lichen was still present and that young trees and plants also bear lichen, which may cast doubt on this figure, although obviously further studies need to be conducted.

Non-lichen monkey foods were found present most abundantly in *Abies spp.* dominated forest where the percentage cover of larger plants and trees is not so high so sufficient light can penetrate the canopy. In general, areas with high lichen are also fairly high in non-lichen monkey foods.

Both the findings from this study, and from previous work (Long *et al.*1994; Kirkpatrick *et al.* 1998) conclude that monkey groups spend the majority of their time in *Abies spp.* (68% of time budget (Kirkpatrick *et al.* 1998)) and coexist with this forest type (Kirkpatrick et. al 1994). This correlates with the greatest amount of both lichen and non-lichen monkey foods being found in this forest type. Also, fir and larch trees are generally the largest trees in the region, hence are the most convenient for travel and provide the best concealment from predators (Long, Kirkpatrick *et al.* 1994). The evidence of *Bryoria spp.* as the prime monkey food is strong, especially on the Nanren east ridge where the borderline between lichen and non-lichen bearing trees also appears to be the boundary of the monkeys home-range on this ridge. Some areas of the monkeys home range are non-fir forest, particularly by the river in Sayong, and here different non-lichen foods grow, potentially due to local forest differences, as suggested by Kirkpatrick *et al.* (1998) However, in general, elevation of *Abies spp.* forest dictates the elevational range of *R. bieti.*

Bryoria spp. was found to be most abundant at higher altitudes and may explain the preference for higher elevations shown by *R. bieti.* There is no systematic data to support high summer and low winter altitude use (Kirkpatrick *et al.* 1998) supported by the range map drawn and the lack of altitude specificity of the non-lichen foods. The monkeys tend to travel further in warmer months (Kirkpatrick and Long 1994) illustrated on the range map as in the fifth and sixth months the Nanren band travel from Yongbao to Sayong. The area most abundant in lichen seems to be just below the summit of Xueshan, so the group would be expected to spend the most time here, but there are many open areas between strips of lichen bearing forest, and monkeys hesitate before walking across gullies between forest patches (this study; Kirkpatrick and Long 1994) probably due to fear of predation which may reduce the suitability of this area as a habitat. The area in which the monkeys spend the longest time appears to be the main fir forest of Nanren, which is rich in lichen and other non-lichen foods. Higher altitudes of this forest are preferred as *Bryoria spp.* is more abundant and the forest is intact- at lower altitudes, deforestation is prevalent, reducing the carrying capacity of the habitat (Zhao *et al*. 1988) and causing fear by human presence.

One of the strongest correlations coming from this study is that between human activity and ranging behaviour by the monkeys. During their study of *R*. *bieti* at Bamei township in 1994, Kirkpatrick *et al.* concluded that the monkeys were disturbed by hunting, logging and the collection of other forest products

and by the ranging of cattle, although in a paper published the same year, Kirkpatrick *et al.* concluded that human activity did not appear to influence the mean altitude of the Wuyapia band (that described in this study), living close to herders yet remaining at high altitudes when human activity above 3500m was minimal (Kirkpatrick *et al.* 1998). Whilst this may be generally true, there certainly seems to be evidence from the range map drawn by people of Nanren that the forests used by the monkeys is determined to a great extent by human activity elsewhere, and rarely go to areas where human presence is high unless to use it as a corridor.

Whilst there are other predators, man is the major threat to the monkeys' survival both directly through hunting and indirectly through habitat destruction. Although hunting of the Yunnan Snub Nosed monkey is banned and carries a maximum prison sentence of seven years, evidence from the wariness which the Nanren group show towards people seems to suggest that some hunting is still occurring (Long, pers. comm.). All hunting is banned within Baima Xueshan Nature Reserve, and in Nanren, which is just outside the Reserve, but not in the surrounding villages, which may explain this.

Chapter 2

Forest Surveys

Forest distribution and history

Distribution of major forest types

The dominant wind direction in the area is from the west; east-facing slopes are therefore generally damp, west-facing slopes are generally drier. Due to the extremely narrow valleys, the majority of the rain falls at altitudes above 3,500m and on ridge tops. There is a transition from damp forests to drier at lower altitudes, eventually being reduced to sparse dry scrub. In the lower parts of the valleys (2,200m–3,000m) trees and tall vegetation are confined to riverbanks and drainage gulleys. The transition to dry vegetation types occurs at a higher elevation on west-facing slopes in this area.

The following is a generalised altitudinal profile of valleys in the region based upon wide-ranging treks and observations. It must be noted that upper and lower boundaries of forests have been grossly affected by human activity, and so it is hard to determine the natural limits.

Wet slopes

Above tree line	Scattered clumps of *Sabina squamosa* on sheltered sites, otherwise alpine heath or pasture.
4,300-4,500m	Where slopes are steep and unsuitable for grazing, *Rhododendron* forms dense thickets around 1-1.5m in height. Otherwise, alpine heath/pasture.
4,000-4,300m	*Abies georgei* / *Larix speciosa*. Composition varies depending on the stability of the slope- *A. georgei* is the dominant on stable slopes, with *L. speciosa* regenerating in large gaps and especially on landslips. On ridge tops affected by wind-throw, *L.speciosa* dominates. *Rhododendron* spp. form a dense subcanopy in places, reaching a height of 4-6m, and is often the first coloniser on landslips. *Sorbus rehdesiana* is also a component of the subcanopy.
3,500-4,000m	*Abies georgei* / *Picea brachytyla* / *Betula alba* (species uncertain) / *Larix speciosa*. Regeneration in small to intermediate size gaps is predominantly *A. georgei* and *P. brachytyla*. In larger gaps *L. speciosa* and *B. alba* are able to establish. These forests are undergoing major changes in composition due to selective logging- see below. There is no overall dominance; *P. brachytyla* increases in abundance at lower altitudes and *B. alba* dominates on extremely wet slopes and in gulleys. *Rhododendron* spp. are reduced in abundance, increasingly replaced by *S. rehdesiana.*
3,000-3,500m	*Pinus densata* / *Pinus armandii.* Form forests of decreasing density at lower altitudes, where *Quercus pannosa* becomes an increasing component as shrubs or small trees. *P. densata* dominates in older forests and on more stable slopes.
2,500-3,000m	*Quercus pannosa.* Forms a dispersed shrub association with other dry shrub species (unidentified).

Where logging or fires have occurred, this pattern is disrupted – see below.

Along rivers and in damp gulleys, another association may form dominated by *Salix cathayana* and *Betula alba*, but also including *Acer* spp. and other broad-leaved trees. *Alnus* spp. are notably absent.

Dry slopes

Above tree line	Alpine pasture, dwarf *Sabina squamosa* on ridge tops.
4,000-4,200m	Where grazing occurs, *S. squamosa* forms a wood-pasture association, otherwise *A. georgei* dominates mixed with *Q. pannosa.*

3,500-4,000m	*Quercus pannosa / Abies georgei.* *Q. pannosa* forms tall forests (c.20m) on the driest slopes, with *A. georgei* confined to gulleys and wet sites. Where there is more rainfall, *A. georgei* increases in abundance, and may entirely dominate (e.g. Nanren valley). *Rhododendron* spp. and *Sorbus rehdesiana* may form a partial subcanopy under *A. georgei*.
2,500-3,500m	*Quercus pañosa* Forms shrub associations as above, may form taller forests on damp sites but these are receding due to logging. On particularly wet sites *Pinus* spp. may dominate.

Recent changes to forests in Nanren area

Two major forest fires (50 and 40 years ago) and the movement of the village to the drylands (upper valley) in the last 30 years have had profound effects on the forests in Nanren valley. Other land uses such as grazing and logging have altered the vegetation over a much longer time period.

Fires

I. The large fire 50 years ago destroyed large tracts of A. georgei / L. speciosa forests- remnants (e.g. the 'sacred forest') confirm that this association was dominant here. Regeneration has come largely from Populus ducloxiana, which forms dense woods mixed with Betula alba. These are about 20-30 years old, and are presently at a height of 15-20m. At lower altitudes, Pinus armandii forests have formed, with increasing amounts of Pinus densata. There is evidence in Nong-yong valley that these forests have receded several hundred metres, probably as a result of the fire and subsequent logging.

II. Two fires 40 years ago destroyed tracts of forests of roughly equal size (c. 2km2) between 3,700 and 4,200m on either side of the valley. In both cases regeneration has been slow and both areas are still lacking in tall vegetation.

On the western side, Larix speciosa is regenerating, but rarely reaching a height of above 10m. Heavy snow loading in winter and severe erosion have impeded regrowth, and much of the slope is now scree with little other than Rhododendron scrub. It is unlikely that this area will return to forest except in the very long term.

On the eastern side, yak grazing has prevented growth of seedlings over much of the area, although in some places a scrub consisting of Rhododendron spp., Sorbus rehdiana and various Rosaceae has formed. Again, there are few signs of forest regeneration.

III. The latter is also the case for extremely large areas of land on the other side of the pass at the southern end of Nanren valley, which are the main grazing lands for several villages. Here it is unclear whether the fires were accidental or deliberate; probably both in different places.

Logging

Since land reform in 1958, large tracts of forest have been cleared to allow for the extension of the village and movement to the drylands. According to estimates of previous forest area from Lu Zong, the ancient *Abies georgei / Picea brachytyla* forests in the base of the valley have been reduced by up to 50%. The land between the upper and lower villages is now used for winter grazing, impeding regeneration of seedlings. *Quercus pannosa* grows as a low shrub, but cutting for fertiliser has prevented them from growing as trees (as in other areas).

Logging still occurs in the remaining forest, extending about 2km inwards. Logging is opportunistic, with no plan- timber trees are simply taken where found. The logging line is continually moving further into the forest as areas close to the village become depleted; the tree stem density in a fully logged area is c. 50% of the original.

Regeneration within the forest is mainly *A. georgei* and *P. brachytyla.* However, the species most in demand relative to its density is *L. speciosa*, which only regenerates in large gaps. Since the conditions for its

regeneration are met infrequently and the demand is so great, it is likely that logging of *L. speciosa* cannot be sustained in the long term- see below.

On the eastern slope, *Betula alba* is being logged for furniture, although this is not at the same intensity as the logging of other species.

On the western ridge, the forests of *Quercus pannosa* have receded c.200m due to logging for firewood in the last 30 years, corresponding to the formation of the drylands village. Only shrubs remain, kept at a low level by collection of leaves for fertiliser. What remains of the forests is now protected from logging, but there is little left, and regrowth from shrubs is slow and severely hampered. Erosion of soils is occuring and may be a problem in future.

Further down-valley on the western slope, there were forests of *Pinus densata* that have been felled for timber and firewood and are now completely cleared. There is regrowth, mainly of *Pinus armandii,* which is protected from logging. This area has been cleared in the last 10 years, leaving only *Q. pannosa* scrub. There are good signs that the *P. densata* will re-grow if left protected and effectively managed (see below).

Cutting of *Salix* spp. and *Populus ducloxiana* also occurs, although these re-grow rapidly and this is of relatively little impact.

Grazing

At many tree lines and in the grazing lands in the valley to the southwest of Nanren, a wood-pasture association of tall *Sabina squamosa* has developed. It is likely that *S. squamosa* has come to dominate over a long time period, probably because it is inedible to cattle. These wood-pastures have clearly been present for many years, although they were probably initially *Abies georgei*-dominated forests.

Although villagers are reluctant to discuss fires, there are clear signs in many places that small areas have been cleared by fire for extension of grazing land. Grazing also brings the associated problem of firewood collection by herders.

Specific threats to forests

As described above, there are several forest types being damaged by human activity, with large implications for the long-term structure of the forests in Nanren valley.

i. Logging of Quercus pannosa for firewood has severely depleted these forests. Continued collection of branches for fertiliser maintains the plants as low shrubs (1–1.5m), and therefore contributes to erosion.

ii. Logging of *Pinus densata* for firewood and timber has almost entirely removed these forests, except for the very young regrowth on the eastern ridge. However, this type of forest regenerates readily, and the main risk is that of long-term erosion.

iii. Removal of Larix speciosa from the forests in the valley cannot continue indefinitely, and it is likely this resource will become severely depleted in the future. Removal of large Abies georgei, Picea brachytyla and to a lesser extent Betula alba are reducing the density of the forests, and will have unpredictable effects on forest composition in the long-term. The immediate problem is the continued movement into the forest, impinging more and more upon the range of the snub-nosed monkey. A combination of noise disturbance and forest damage may be reducing the effective range of the monkey.

iv. There is substantial evidence in the logged forest that fungal infections are spreading among mature trees. It is likely that logged stumps are colonised by pathogenic fungi, which spread through root systems to healthy trees. Areas of infected *Abies georgei* and especially *Picea brachytyla* are much more common in logged forest. The implications are that younger trees will be affected, reducing the stem density in the forests still further after logging. The greatest risk is that of an epidemic.

Unfortunately, there is no easy way to incorporate protection, e.g. fungicides, with traditional logging practices.

v. Before cutting conifers, it is common to strip the bark off the base of the tree on one side to check the grain of the wood, and often to cut into the core to check whether the heart is still intact. Trees that are rejected still face a very high mortality due to the damage caused and the increased risk of fungal infection. This is unavoidable if trees are to be checked before cutting, and adds to the number of trees killed by logging. Along paths there is also occasional ring-barking of trees, which serves no purpose and is fatal. This should be discouraged.

Conservation and management priorities

It is likely that forestry plantations will play a vital role in providing for future timber needs in Nanren. It is essential that specialist advice is sought for projects – the following are merely suggestions for possible schemes. The proposed movement of the village to the wetlands provides a unique opportunity for effectively managed plantations in the upper valley.

i. Demand for *Larix speciosa* is likely to be ongoing, and movement to the wetlands would require large amounts of timber, as many people will choose to build new houses. It is possible that *Abies georgei* and *Picea brachytyla* could be used as substitutes, although the wood is less durable and long-lasting, so it is likely that this would lead to more frequent replacement of housing beams and increased logging of these trees.

   There is more abundant *L. speciosa* on the eastern slope of Sayong valley, which has remained due to the inaccessibility of the steep slopes. However, aside from the practical difficulties, logging here cannot be advocated due to the risk of fires and erosion- as in Nanren, regeneration here is likely to be very slow.

   Larix spp. are extremely responsive to good management, and a plantation could provide timber in the long term if established soon, or firewood in the shorter term. However, housing timber would need at least 50 years growth, so the problem if depletion cannot be avoided. Also, a *Larix* plantation is unlikely to provide useful monkey habitat, although it may protect those forests which remain from logging in the long term.

ii. On the western ridge, planting and the reduction of competing shrubs could encourage the regrowth of Pinus densata. There is already trimming of lower branches to ensure tall, straight growth for timber; this could be extended to a full management of the forest. Continued protection of this area is recommended to allow regeneration. The value of this protection is purely economic; there is little of obvious conservation importance in these forests. The risk in the long term is of further erosion and receding of the forests upslope.

iii. In 1996, the Forestry bureau provided seedlings of *Abies georgei* to be planted on the eastern ridge underneath *Populus ducloxiana*. It is likely that this provides some protection from winter snow, however, *Populus* spp. are clonal, and the dense canopy is likely to impede their growth to a large extent. The survival of these seedlings should be monitored, and the replanting extended, but it may take over 100 years before an *Abies georgei*-dominated forest is able to reform in this area.

iv. There is little that can be done to replace the lost *Quercus pannosa* forests. Regrowth is slow, and continued demand for fertiliser will maintain the remaining plants as shrubs. Since the forests are used by monkeys to some extent, those that remain should continue to be protected.

v. In terms of preventing further encroachment into monkey territory, it may be possible to introduce some systematic strategy to logging in the valley, so that disturbance of the monkeys is minimised. The present situation means that logging is spread over a large area of forest.

Species accreditation

Abies georgei Orr. (*Abies delavayi* Franch. var. *georgei* Orr.)
Picea brachytyla (Franch.) Pritz.
Larix speciosa
Pinus armandii Fr.
Pinus densata
Sabina squamata (Bach.-Hamilt.) Ant. (*Sabina lemeeana* (Levl. et Blin.) Cheng et W.T. Wang)
(*Juniperus squamata* Buch.-Hamilt. aqud Lamb.)
Populus ducloxiana Gamb.
Betula alba
Sorbus rehdesiana Koehne.
Quercus pannosa (Hand.-Mzt.)
N.B. extremely similar to *Q. aquifolioides* (Rehu. et Wils.); separation difficult.
Salix cathayana (Diels)

Chapter 3

Socio-economic Survey

Introduction

The social research project aimed to study:

- Village history
- Resource use
- Cash and non-cash economy
- Village management systems
- Future aspirations

Addressing these helped us to reach a clearer understanding of issues of past, present and future conflicts with conservation of the snub-nosed monkey and its habitat. Since the monkey's habitat is congruent, to some extent, with the resource areas used by the people of Nanren, conservation issues are also closely linked to the future of the village economy.

Issues surrounding the future of the monkeys of Baima Xueshan, and the inhabitants of Nanren, on the other, are therefore hard to separate. Unfortunately, conservation management and rural development policy in the area have hitherto often appeared poorly integrated. The management of the Baima Xueshan Nature Reserve, for example, has a clear conservation-oriented brief, and its influence on local inhabitants has sometimes been adverse, both by the admission of the reserve management, and according to the local people. While the problems of the conflicts between economic development and environmental conservation may appear as intractable in Nanren as they are anywhere else, attempts at resolution of any of these problems must begin by the identification of the precise nature of the conflicts, and this was the central aim of the social research project.

PRA Methods

Participatory Rural Appraisal (PRA) techniques have evolved in an attempt to allow research that, though ultimately conducted by outsiders, nevertheless uses local people's perspectives and reflects local people's priorities. 'Traditional' techniques in social research have often tended merely to reinforce the existing assumptions, beliefs or prejudices of outside researchers, and at the same time further to entrench the unequal relation between the powerful outsider and the powerless local people, or between a powerful narrow local elite (usually rich and male) and a powerless local majority (often poor and/or female).

The philosophy underlying PRA techniques is that much of the control of the research should be in local, rather than outsider, hands. In practical terms this means that it is local people who should control the data, both during and after its creation. Techniques used included participatory mapping (social, resource, conservation, future); transect walks; seasonal calendars; freelisting and ranking; and well-being flow diagrams. As far as possible, these research exercises were carried out in groups, usually with a mix of young and old, rich and poor, and male and female. On certain occasions, though, separate groups were formed in order to compare the findings of, for example, rich and poor, or male and female. Where possible visual exercises were used, using a minimum of written language which few would understand, and instead relying on simple drawings or symbols. Working on the floor in theory allowed as many people as possible to be directly involved in the drawing of maps, diagrams, etc., though in practice we found that nevertheless certain members of the group tended to dominate.

Summary of results

Nanren is village of some 280 inhabitants, most of whom are primarily engaged in agriculture for subsistence. Most of Nanren's agricultural land is non-irrigated drylands, which are relatively unproductive, and vulnerable to frost. In the irrigated wetlands, two crops a year are grown; the lower altitude makes frost

less of a threat, and a wider range of crops are grown. The dryland crops are: potato, turnip, barley, oats, and wheat. These are also grown in the wetlands, where there is in addition: buckwheat, sorghum, beans, a range of fruit trees, maize, and a small area of rice. Each household also has a garden in which an often-wide range of vegetables, fruit and herbs are grown.

Livestock husbandry is also an important part of the Nanren economy; yaks, cows, sheep, goats, pigs, horses, donkeys, mules, and chickens are all raised. Yaks and cows are an important source of milk products, and yaks, horses, donkeys and mules are valued as pack animals. Sheep, goats and pigs provide manure; in most cases, their role as a food source is considered secondary.

Although the Nanren subsistence economy is primarily agricultural, non-agricultural cash products from the forest and mountain areas are form the basis of the limited cash economy. These products include: various mushrooms, especially song rong; insect herb (chong cao); snow lotus; snow tea (xue cha); and mountain medicinal plants including zhimu and beimu.

The collection and marketing of these products is usually the focus of household labour efforts once the main agricultural tasks have been dealt with. Those households with plentiful labour are thus better able to exploit these cash resources; those with few adult members may have no surplus labour to engage in non-subsistence activities.

To reach Deqin, the nearest market centre from Nanren, requires either a 12-hour walk over a 5,000 m pass, which is often impassable during winter months, or a 3-hour walk to the roadhead at Xincun, from where onward transport may or may not be available. Xincun is around six hours' drive from Deqin. Nanren's inaccessibility makes the marketing of these forest and mountain products difficult and time-consuming. Access to up-to-date information on prices in local markets is limited, and transporting products to market is also problematic. Again, households with labour shortages are most disadvantaged, and the two-child policy enforced in Nanren is unpopular among local inhabitants for this reason.

The local markets for forest and mountain products are highly volatile, with prices fluctuating by as much as 500% in the space of a few days. Nanren people are not only poorly placed to exploit favourable market conditions, but are also highly vulnerable to periods, sometimes of years, when the markets are poor or even non-existent.

Cash poverty in Nanren is therefore endemic. Agricultural poverty has, on the other hand, been reduced since the introduction of the 'household responsibility' system in the early 1980s. Before then, food insecurity was a major problem and near-famine conditions prevailed in a number of years. Today, the situation, though improved, remains precarious, and a climate- or pest-induced crop failure would certainly cause very severe hardship.

In addition to cash poverty, inaccessibility, and precarious food security, Nanren has an underdeveloped basic infrastructure. A fairly reliable water system was installed several years ago that brings water through a trench system to within 50 yards of all the houses in the drylands. (38 of Nanren's houses are in the dryland, 4 in the wetlands.) The quality of the water is unknown – diarrhoea is a major health problem in the village. There is no telephone line to the village. Electricity supply from a micro-hydro plant is limited to around 60W per household for about three hours a day.

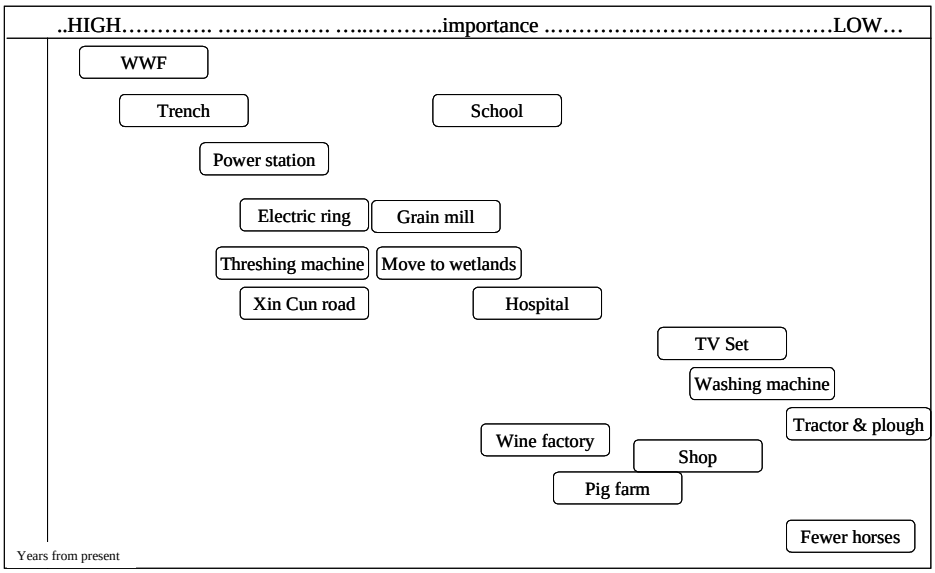
Nanren is a poor village in one of the poorest areas of China. Its development needs are particularly pressing, yet available funds are few. It is also in a highly ecologically sensitive area, and its territory includes Nature Reserve land and snub-nosed monkey habitat. In meeting their own basic needs, it is clear that Nanren's inhabitants have an impact on this habitat. The most obvious current problem is the retreat of the oak tree forest, which is harvested as a source of firewood and mulch fertilizer. Not only is this leading to habitat destruction; fuelwood and mulch collection times have doubled in a generation; and the denuded slopes are now liable to erosion and the village more vulnerable to sheetwash flooding. Villagers say that they will be forced to begin to cut firewood in the mixed valley forest within the next few years if no fuel substitute becomes available.

Construction timber is taken from the mixed forest in the Nanren valley, and while there is no current shortage of suitable timber, some villagers noted that it has become necessary to venture further into the

forest to find timber. However, the amount of timber taken from the forest is likely to increase sharply in the coming years if the villagers' desire to rebuild their village in the wetlands is realised.

The rebuilding of several houses per year over a decade could entail serious deforestation and thus a potential threat to monkey habitat. Local livelihoods are, however, also heavily dependent on the survival of the forest, and villagers therefore plan to afforest part of their current drylands fields if the move to the wetlands can be effected. The conservation and economic benefits of this afforestation would depend on the species planted and the management strategy adopted, and this is an issue on which villagers could usefully work with forestry specialists.

Nanren's future development aspirations are summarized in Figure 1 (below), which was created by a group of Nanren villagers.



• **Figure 1** Future aspirations timeline

WWF: Visit from WWF PRA team expected in the fourth quarter of 1999; participants hoped for positive outcome and possibly financial assistance for projects.

Trench: Concreting the lower section of the main irrigation trench to Gemen wetlands.

School: Hope that the new school will provide a better education, helped by a good teacher; will enable children to learn good Chinese.

Power station: A new power station with increased generating capacity that will enable villagers to use a range of electrical appliances (see below).

Electric ring: Cooking on wood fires is labour intensive because firewood is difficult to collect, and is becoming more so suitable forest areas retreat further. Electric rings could reduce the amount of firewood required.

Grain mill: The village recently acquired a diesel-motor powered grain mill; this could be replaced by an electric motor.

Threshing machine: could replace current manual flails.

Xin Cun road: A road from Nanren to Xin Cun would connect to the Yangla-Deqin Highway, which would greatly improve Nanren's access to markets, services, etc.

Hospital: This would be built in the wetlands after most households have relocated there, and could provide a reliable basic medical service.

Wine factory, pig farm: If Nanren had road access, they could sell agricultural products, including barley wine, to local markets.

Shop: Although the village has a small shop, it supplies only a restricted range of goods; for many basic items people must currently travel to Deqin.

Fewer horses: With road access and access to motorised transport, people could reduce the number of horses, donkeys and mules needed for transporting goods, crops from wetland to dryland, etc. This would enable them to use their (limited) grazing land for raising more cattle and sheep.

N.B. Not marked on the diagram, but a universally-held hope within the village, was for an expansion of the irrigated wetlands fields and a gradual transfer of the village itself into the wetlands.

The possible threat to the forest from increased construction wood requirements has been discussed above. Staff at the nature reserve were also concerned that any road-building activities in the village could also threaten forest habitat, both directly by clearance and disturbance, and indirectly by enabling more potentially-disturbing economic activity to take place in and around the forest areas.

An improved power station might have a positive environmental impact by reducing the need for fuelwood, which is currently used for all cooking and heating requirements in the village. Fuel-efficient stoves may also have a role to play, but there is concern that they may not provide adequate heating for the large Nanren houses in the winter months.

Conclusions

The fulfilment of Nanren's future development aspirations will depend on the availability of funding, which at the moment and for the foreseeable future is likely to be limited. It may also depend on gaining the approval of the management Nature Reserve, and where development and conservation are perceived to conflict, this too may not readily forthcoming, although the degree of actual authority that the Reserve enjoys over Nanren is not clear. Nanren village itself is not within the current boundaries of the Reserve, though some outlying Nanren territory is.

Outside expertise could be usefully employed both to enable certain development projects within the village, and to attempt to harmonise these projects with the requirements of local environmental protection. Schemes in which outside assistance might be both helpful and welcomed locally include afforestation or plantation projects; power station enhancement; forest products marketing; and road building. Such assistance could probably be provided by institutions at the provincial or even more local level. However, the resources of such institutions are often stretched and thus there may be a role for national-level institutions or even international NGOs in the future.

There is a high level of awareness of conservation issues in Nanren, prompted partly by the increasing international interest in the snub-nosed monkey and its habitat, which has brought a number of research teams to Nanren. There is also a clear appreciation of the increasingly obvious fact that forest resource depletion is making basic subsistence activities more difficult and time consuming, and there is thus a strong local desire to find suitable and practical alternatives.

Nevertheless, until people's basic needs and wants can be reliably met, it will be difficult to impose unpopular conservation restrictions, and they are likely in any case to be ineffective if voluntary local cooperation cannot be assured.

If the expansion of the wetlands and move of the village to the wetland area are effected, local living conditions are likely to be significantly improved. Villagers cite better crop yields and lower agricultural risks, lower labour input requirements, and more favourable climate in explaining their desire to relocate. If this relocation can be achieved without unacceptable environmental cost, a level of economic security in Nanren may be attained which might allow a more successful integration of development and conservation priorities in the future.

Chapter 4

Accounts

Income

Dr Walker	50
Royal Geographical Society	2,000
Television Education Trust	60
People's Trust for Endangered Species	750
Gilchrist Educational Trust	1,000
Sidney Sussex College	250
Christ's College	250
Devon-Cambridge Society	100
International Federation for Animal Welfare	3,000
Dr Owen	50
Cambridge Expeditions Fund	600
Chester Zoo	500
St George Expedition Award	500
David Conservation Trust	150
Foreign and Commonwealth Office	1,000
Primate Society of Great Britain	250
Explorer's Trust	737
Royal Zoological Society of Scotland	500
Cadbury Ltd.	1,000
Jardine Matheson Group	909
Team contributions	2,400
Total	**16,056**

Expenses

Accommodation	1,254.89
Clothing	175.00
Communications	97.15
Entertainments	19.85
Equipment	1,987.97
Food	1,268.05
Gifts	381.92
Medical & Insurance	2,535.66
Photographic	203.21
Pre-Expedition	367.89
Reconnaissance	781.21
International Travel	1,211.05
Local Travel	2,415.09
Wages	616.15
Total	**13,315.09**

The cost of printing and distribution of the final report is still to be added to this, but that still leaves some excess. It has always been the intention of the project to "give something back" to the village of Nanren for working with us, so we spent some time investigating how we can do this. After studying the future aspirations of the village and weighing in what could be afforded and was viable from an environmental perspective, we have decided to donate the money to build a pipe to provide drinking water to the wetlands. We are in the process of negotiating a relationship with The Nature Conservancy and Baima Xueshan Nature Reserve Administration as a means to distribute the money.

Chapter 5

Acknowledgements

This project was made possible through the support of: Cadbury Ltd; Jardine Matheson Group; Psion Ltd; Vango, and funding from: FCO Environmental Department; Explorers' Trust; Lord Owen; Royal Geographical Society (Rio Tinto Foundation); Television Education Trust; People's Trust for Endangered Species; David Conservation Trust; Dr Walker; Chester Zoo; Gilchrist Educational Trust; Sidney Sussex College Cambridge; Christ's College Cambridge; Royal Zoological Society of Scotland; Devon-Cambridge Society; International Federation for Animal Welfare (IFAW); Cambridge Expedition Fund; Primate Society of Great Britain.

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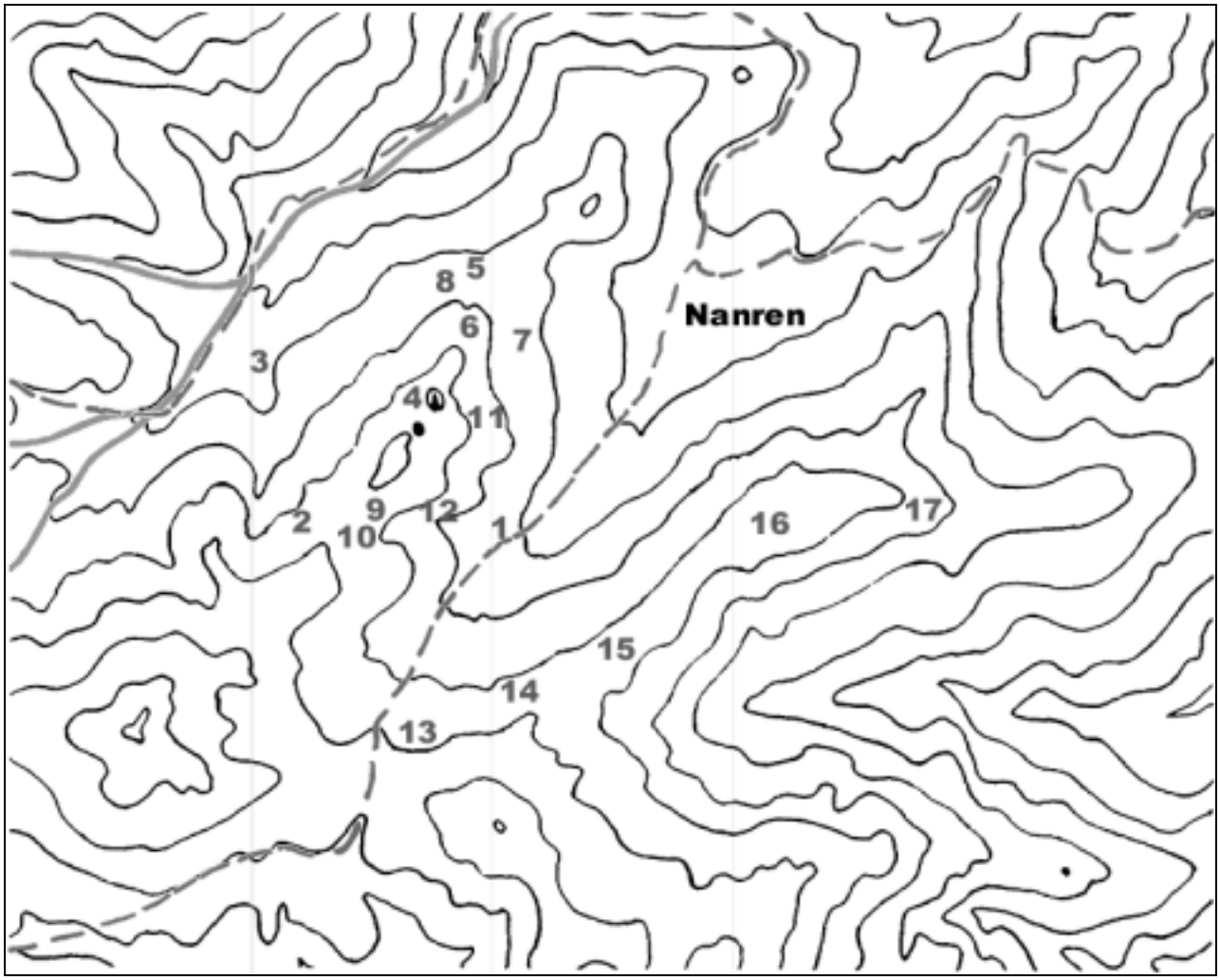
Appendix 1

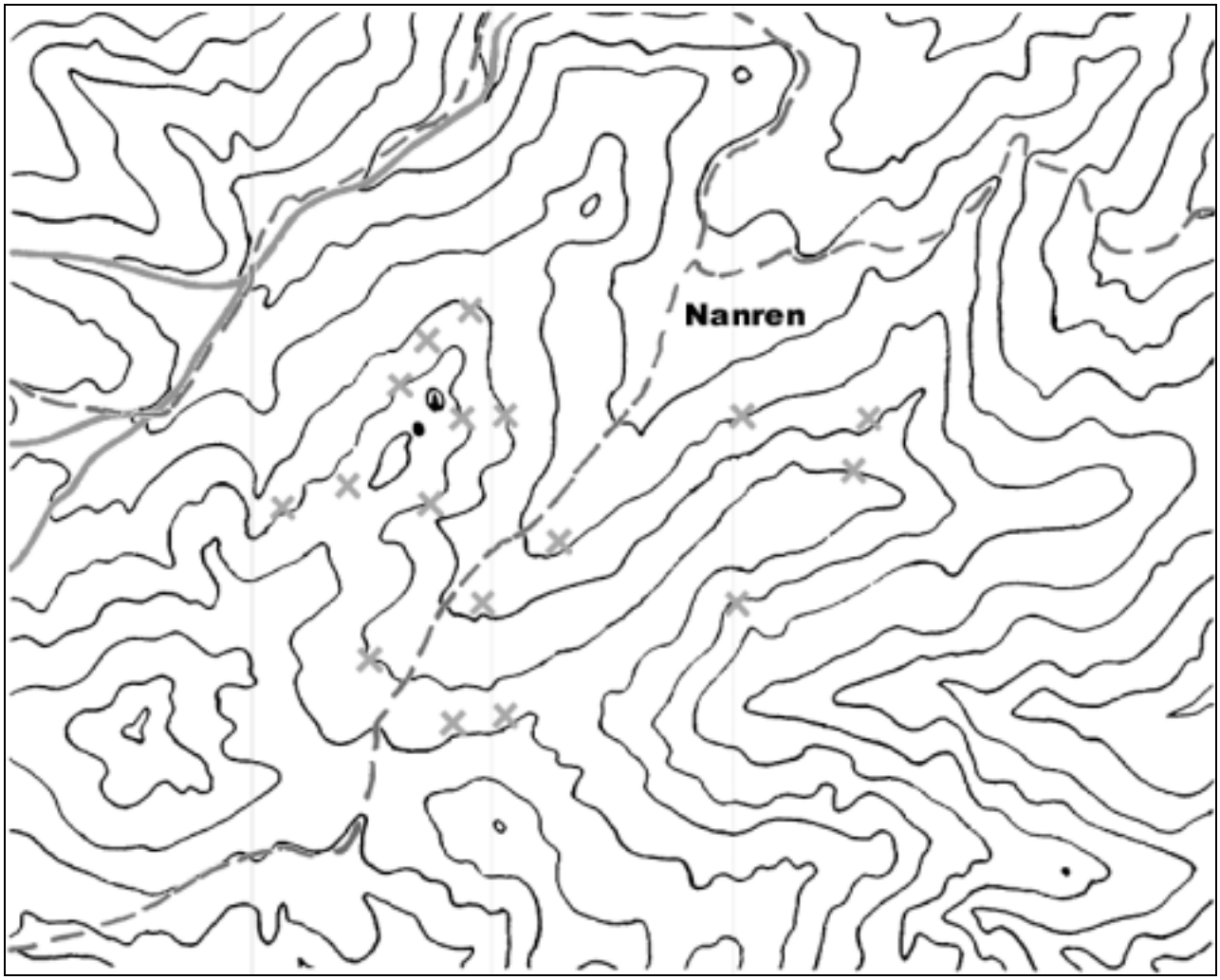
Primate Ranging Behaviour



• Locations of direct observations throughout the study period.

Appendix 2

Food Distribution



• Locations of botanical surveys quantifying monkey food distribution.