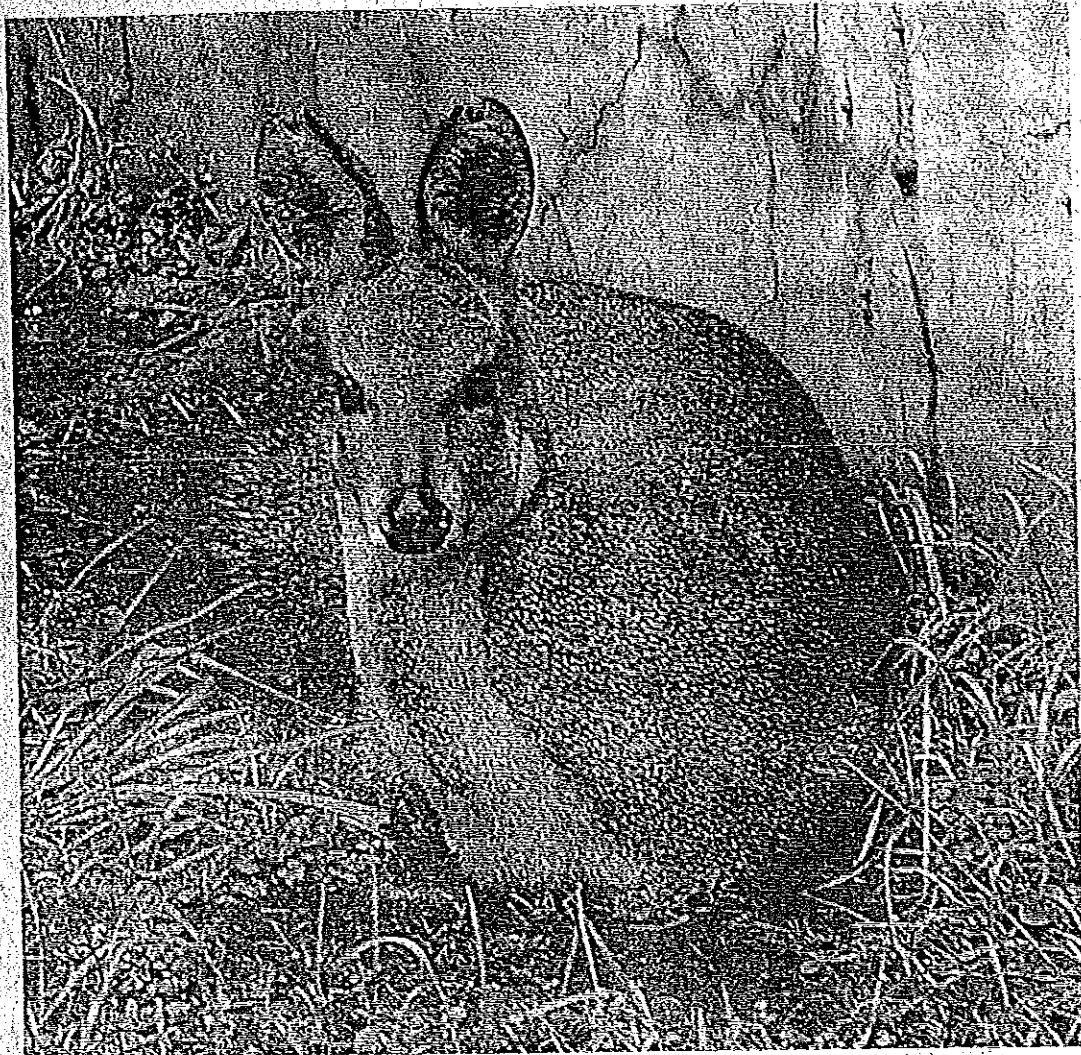


Musk Market Survey Report

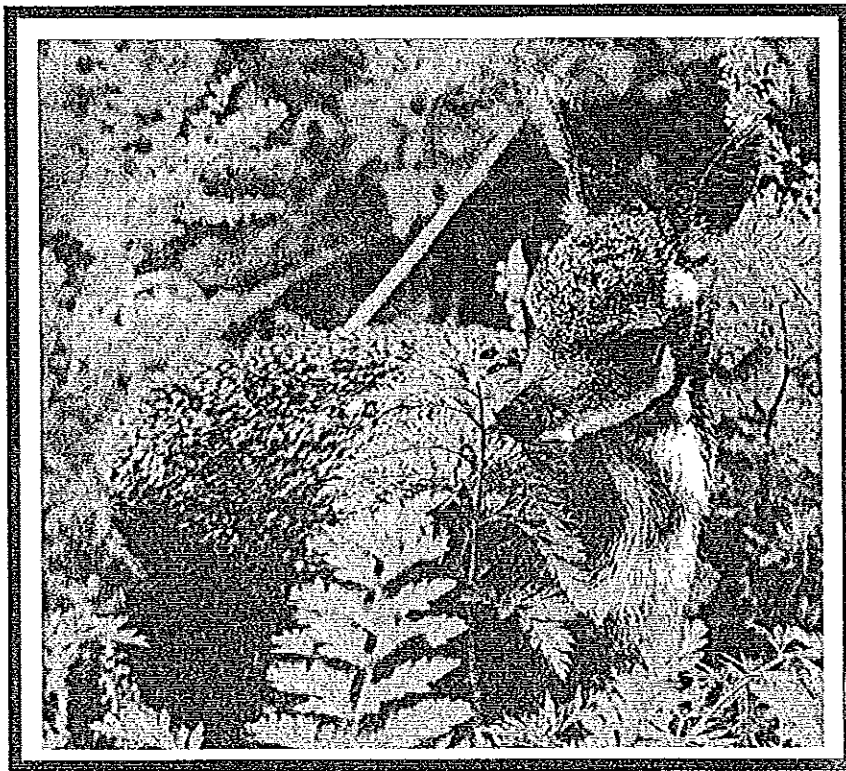


Endangered Species Scientific Commission
of the People's Republic of China

March 30, 2002

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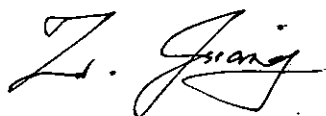
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Executive summary

Musk is one of the most valuable natural products in the world. China is a major range country of musk deer, which locates in the center of the range of musk deer. With about 70% of world musk production, China is a main musk consuming country. Musk has been in use for traditional medicine, incenses, perfumes for thousands of years in the oriental countries, Middle East and some European countries. It was reported that musk is listed in 398 patented Chinese medicines which using musk as an ingredient and 295 of the recorded 2621 Chinese Traditional pharmaceutical preparations as well as many herbalist preparations. Thus, traditional medicine is the main consumer of musk.

Since the creation of Convention on International Trade of Endangered Wild Fauna and Flora Species (CITES) in 1975, the musk deer populations in India, Nepal and Bhutan are listed in the CITES Appendix I while the rest of musk populations are listed in Appendix II. During the 11th Convention of Parties of CITES and the 16th Animals Committee meeting of CITES, the international trade issue of musk is a hot topic. A survey on the consumption of musk in Europe was conducted by TRAFFIC Europe in 1999, a investigation on musk deer farming in China was carried by TRAFFIC East Asia in 2000. Musk deer is also one of most concerned resource animals in China. However, due to various reasons, there is no accredited data about the musk resource status, musk production, musk consumption, musk in storage and the network of sale, though the information are important base line data for solid management of musk trade and musk deer population.

From June 2001 to March 2002, the Endangered Species Scientific Commission of the People's Republic of China (ESSC, The CITES Scientific Authority of People's Republic of China) conducted a musk market survey under a contract with the CITES Secretariat. The objectives of musk market survey were: (1) To estimate amount available of musk in major traditional Chinese medicine (TCM) and other traditional ethnic medicine (mainly traditional Tibetan medicine) markets; (2) To assess the

annual volume of musk used by TCM manufacturers; (3) To project the sustainability of using musk through analysis of its market value and annual domestic demands and supplies of musk. For thoroughly assess the ecological, economic, and social impacts of strict measures on international musk trade, we also include some basic economic and social items in the questionnaires.

We surveyed traditional TCM markets and important musk producing regions in China, we also conducted investigations on the use of musk and its substitutes by TCM manufacturers by questionnaire and market visit, at the same time, we gathered information about musk deer and musk trade through extensive archive searching.

Since the musk deer are widely distributed with relatively high population density in their habitats. It was speculated that in the past, before 1950s, the habitats for musk deer were around 2,000,000 km² and those habitats were inhabited by musk deer with densities ranged from 0.01 up to 51.00 /km². The population size of musk deer decreased from 3,500,000 in 1950s to 1,000,000 in 1990s, then decreased to about 500,000 in 2000. Thus, in 46 years the musk deer population has decreased nearly 90% in China. Thus such a low population density actually means the musk deer populations are economic extinct in some areas.

Since the economic reform in China, the State tried to strengthen the control of illegal musk trade. But due to opening of market and price, reform of economic system, the sale of musk is gradually out of the control; there is no reliable statistics of musk sale and trade. Because of trade in black market and lack of trade records, it is difficult to obtain the present musk production. We can only estimate the production according to available information. For example, from 1983 to 1988, 399 kg musk were produced in the Tibet Autonomous Region; the State owned companies only bought about 198 kg, half of the musk production went to black markets.

From 1956 to 1986, the annual average sale of musk was about 1,900 kg, the trade of musk by the National Corporation of Traditional & Herbal Medicine was nearly balanced during that period. Of the musk trade during that period there were some imported musk. Form 1956 to 1978, the annual musk production in China fluctuated

between 1,000 ~2,000 kg. If the indigenous people used about 10% of musk, then the annual production of musk was about 2,000 kg in China during 1956 to 1978. Theoretically, to produce 2000 kg musk, it needs to hunt 400,000 musk deer. Based on the 25% annual population growth rate, a stock population of about 1.5 ~2 million musk deer is needed to maintain such a musk production.

In this survey, we altogether mailed out 958 questionnaires to TCM pharmacy companies, TCM companies, provincial wildlife management authorities and TCM markets all over China. Despite of all efforts from the ESSC, only 379 questionnaires were answered and returned to the ESSC office. The returned rates of those questionnaires were low in both corporation of traditional and herbal medicine sector and TCM company sector. Particularly, we only collected less than four per cent of the questionnaires we sent to the TCM companies. Even though, we had little feedback from the corporations of traditional and herbal medicine and TCM manufacture companies, we finally consulted the TCM professionals about the quality of data. Most of the provincial wildlife management authorities answered the questionnaires. We also had most of questionnaires sent to the TCM markets answered, because we made arrangements to send out and to collect the questionnaires. Due to the sensitivity of the musk trade and the promise we made during the investigation, the questionnaires, source of correspondence, and communication are kept anonymous in this report.

We visited three corporations of traditional and herbal medicine and six TCM companies. We also visited TCM pharmacies, TCM raw material markets, and local wildlife management authorities Lhasa, Rikazhe, Lanzhou, Yingchuan, Guangzhou, Guilin, Nanning, Chengdu, Chongqing, Kunmin, Changsha, Yulin, Wuhan, Zhangzhou, Ningbo, Yichang, Beijing, Shanghai and Xiamen. Besides these cities many small herbalist clinics, herb pitchmen, former hunters and local wildlife management authorities were investigated in Fengjie, Diqing, Zhongdian, Weixi, Yanlin, Changdu, Linzhi, Dingri, Leiwuqi and Dujiangyan. We also visited local TCM pharmacies, local market, local wildlife management authorities and local people to investigate the

musk trade in Dali, Yunnan Province (May, 2001), Hunan Province (Oct. 2001) , Chongqing City (August, 2001), Diqing, Zhongdian, and Weixi in the Yunnan Province (August, 2001), and Yanling County, Hunan Province (September, 2001), Changdu and Linzhi, east Tibet (October, 2001), and Dujiangyan City, Sichuan Province, the Lhasa and Rikazhe, south Tibet (January , 2002). All the regions are historically important musk producing regions..

Based on the information from these questionnaires and the other resources, the total number of the farming deer in China at the end of 2001 was 2145. There was still unverified information that some small musk deer family farms exist at various remote locations. Thus, a total number of musk deer in captivity in China is estimated around 2,500 at the beginning of 2002. If about one third of the farmed male musk deer are able to produce musk and the musk production per male musk deer is 7 g per year, the 700 ~ 830 male musk deer can produce 4.9~5.8 kg musk.

The state run or the shared TCM manufacture companies used to obtain all their musk from the State run corporation of traditional and herbal medicine during the planned economy period. Now, this channel of musk inflow to the TCM companies is greatly reduced. Thus, the TCM companies have to get supplementary musk from "free market" (free market refers the designated market for trade by the State Industry and Business Bureau) to make the ends meet. According to the musk sale records of eight corporation of traditional and herbal medicine from 1996 to 2000, the maximum purchase was 400 kg in 2000, the minimum purchase was 150 kg in 1996. The predicted amount of the musk demand of individual TCM company varied between 500 to 25,000 g, the average demand was 1,000g. Thus, the demand of natural musk of the 1000 TCM manufacturing companies national wide will be 1,000kg. The average musk consumption of TCM manufacturing companies in China in the 1980s varied between 3,000 ~5, 000 kg. In this investigation, the demand for musk is greatly reduced. One of reasons is that it is a common practice in TCM industry to use synthetic musk due to the shortage of and the adulteration of natural musk.

Though the effectiveness of synthetic musk is in disputing, among these substitutes of

musk, only synthetic musk is commonly used in manufacturing TC, other substitutes such as, musk scents of muskrat (*Ondatra zibethica*) and oriental civet (*Viverra zibetha*) are still at the experimental stage.

The attitude of Chinese TCM industry towards using synthetic musk in their TCM products is hastate and reluctant. Of the 13 TCM companies involved in the musk market survey, when asked whether they will clearly label their TCM products that it contains synthetic musk instead of natural musk, the 22.2% companies answered "Yes" to the question, 27.8% answered "No", while 50% of those companies did not say "Yes" or "No". TCM contains natural musk is of course more attractive and acceptable to consumers than those only contain synthetic musk.

In the returned questionnaires, five of the thirteen TCM companies still use natural musk (38.5%), eight used synthetic musk (61.5%). Nine of the 21 TCMs manufactured the nine TCM manufacturing companies contain natural musk, three TCMs contain both natural and synthetic musk. In 2000, total consumption of synthetic musk in the thirteen TCM companies was 160kg. The total annual consumption of synthetic musk in China was more than 1,000 kg in 2001. Many TCMs claim to contain musk ingredients only synthetic musk or trace of natural musk.

The consumption of musk of the 13 TCM manufacture companies was 67 kg per year; averagely each TCM manufacture company uses 7.4 kg (0.5~16.0 kg) musk. Compared with the annual musk consumption of 288kg in five TCM companies reported by Guo *et al.* (1996), musk consumption by the TCM industry is decreasing. Of the 21 TCM prescriptions used by those investigated TCM companies, 11 still use natural musk. There are six main traditional Tibetan medicine companies in Tibet; all of them use musk to make traditional Tibetan medicine. Among those traditional Tibetan medicine companies, the largest one consumes about 5~12 kg musk per year, while the rest of the companies consume 2~6kg musk each per year. All together, about 20~50 kg musk are needed for manufacturing traditional Tibet medicine annually.

The estimated lower limit and upper limit of musk production in China are between 1,300 kg and 2,500kg. Adulteration of musk is common. Take this factor into consideration, the lower limit and upper limit of the musk production in China is now between 750 kg and 1,250kg. We estimated the annual musk trade in these corporations of traditional and herbal medicine is about 500 kg. Therefore, to maintain such a musk production, it at least about 400, 000 musk deer stock population.

The number of employers in the 13 TCM companies was 6,027; average production value per capital was 15,653 Yuan RMB yearly. The TCM products that contained natural musk were 1.12% of the total production value in those TCM companies. Averagely the production value of the TCM produced per kilogram natural musk was 340,000 Yuan RMB. The value of TCM products that contained synthetic musk was 9.34% of the total production value of those companies. Averagely the production value of the TCM produced per kilogram synthetic musk was 400,000 Yuan RMB. Production values of two kinds of musk of TCM products accounted for 10.46% of total production value of those TCM companies. The production value per kg synthetic musk is slightly higher than that of natural musk. However, if take the adulteration of natural musk into consideration, which may as high as 50%, then the production value per "natural musk" is as high as 680,000 Yuan RMB/kg.

Thus the production value of TCM that contains musk is not a big share in the total TCM production value. However, as one of thousands of TCM raw materials in China, musk plays an important economic role. Average 22 jobs are created per 1 kg musk consumed in the TCM industry. If we take TCM pharmacy, hospital and transportation and so on in account, more jobs may be created.

Considering the status of musk deer populations in the field, strict measures of controlling both international and domestic trades, including listing the musk deer to Class I national protected wildlife as well as to CITES Appendix I, are under consideration. We analyze the following possible conservation measures: to ban all use of musk in TCM, to trade musk with special concession, to legislation, manage

wild musk deer for sustainable musk production.

Regardless the disputing opinions toward the wild musk population status, the musk deer are threatened. Therefore, to ban all use of musk in TCM is one of measures that we should consider first.

Thinking about that synthetic musk is now commonly in use in the TCM industry, ban all use of natural musk in the TCM industry is feasible. But the TCM industry is still skeptical about the effectiveness of synthetic musk. Some of TCM companies used synthetic musk in their products due to shortage of natural musk and quality degradation in natural musk. Ban all use of musk means that TCM cannot have musk ingredients regardless whether the TCM product is labeled with musk or not. To take such a measure it will bring forward a shock to the TCM industry and the society.

There is evidence that smuggling is major threat to the survival of musk deer. Musk deer live in remote, underdeveloped areas. The musk priced for 500,000 Yuan RMB/kg in the international markets, and only priced for 200,000 Yuan RMB/kg in the domestic black markets. To poach a gram of musk it means 200 Yuan RMB of income. Thus the drive of poaching musk is mounting. If there is no other means of effectively controlling the illegal international trade of musk, the ban may be just something on the paper. The network of smuggling musk is now well in shape. Compared with the drug smuggling, musk smuggling is of far less risk but highly profitable. At the end of the survey, we have these questions remain unsolved: where does the smuggled musk go? Who use those musk and for what purpose?

Musk is of important culture, economic and social significances. Traditional medicine is important to the world population; the traditional medicine links millions and millions of people. Musk is one of the key ingredient that with irreplaceable effects in some TCM. Whatever measure we are going to take in future, we should take cautious steps. First we should fully assess the present status of musk deer populations, second, we should determine the main causes of threats to musk deer, and finally we should evaluate the impacts of the measures on the live of people and make suitable

arrangement. We thus recommend (1) To maintain the CITES Appendix II status for musk populations in China whilst strength domestic and international trade control. The musk export with CITES permit was not the major part of the musk consumption in China. Even the musk deer are all included in the CITES Appendix I, we still do not know whether such a measure can effectively curb down the musk smuggling and stopping all use of musk. If no other match measures are taken simultaneously, because of its wide use in orient traditional medicines. Such a move will stimulate the smuggling of musk. Under current circumstances, the effective measure is (1) to improve the management of domestic trade and use of musk in China, and curb down the poaching of musk deer and illegal trade of musk; (2) To resolve the scientific, technological, economic, and management problems in the sustainable use of musk through extensive and effective international cooperation. The input to musk deer captive breeding is not enough to match the importance of musk to the medical use. Except other reasons, the underdeveloped economy and the potency of its scientific ability may be the reasons.

Introduction

Musk is the secretion of the musk scent sac – the preputial gland--of male musk deer, which located between the navel and the genitals (Homes, 1999). Main ingredient of musk is muscenes and proteins. Male musk deer start to secrete musk at the age of two years old and continue the secretion until the age of 20 years old (Green, 1989, Sheng et al., 1993). Musk is used to mark the territories by male musk deer and as a sexual hormone to attract females during the breeding seasons.

Musk has been in use for traditional medicine, incenses, perfumes for thousands of years in the oriental countries, Middle East and some European countries. For thousands of years, musk is used for high-class perfume ingredients and as traditional medicine (Green, 1983, Groom, 1999). The musk, which is famous and appreciated for its fragrance, is one of the most valuable natural products in the world. In China, a gram of musk is sold for 200-300 Yuan, RMB (US\$25-40).

China is the most important musk deer range country, which has all the musk deer species, whereas China is also a main musk consuming country. As a major component of the traditional East Asian medicine (TEAM), the Traditional Chinese Medicine (TCM) uses herbs, animal products and minerals to treat illness of people and domestic animals. Wildlife is used for this purpose for thousands of years. Such a situation in the developing countries is recognized by the WHO. Musk is used in traditional Chinese medicine, and also in Korea and Japan where their traditional medicines originally come from China, as a sedative, an antipyretic and a stimulant, to treat a variety of ailments of the traumatism, heart, nerves, and breathing is therefore one of the most commonly used animal products in this type of medicine. It was reported that musk is listed in 398 patented Chinese medicines using musk as an ingredient (Pharmacopoeia of the People's Republic of China, 1991) and 295 of the recorded 2621 Chinese traditional pharmaceutical preparations as well as in numerous herbalist preparations. Therefore, due to its wide application, musk has a

critical influence on traditional medicine, which can be considered a part of indigenous culture in some Asia countries.

Musk has also been used for hundreds of years in the perfume industry in Europe as fixative of high graded perfumes (Pilz, 1997 and Müller, 1991). But according to official trade records, the perfume industry in France did not consume a large proportion of musk; therefore, the traditional medicine may be the largest market for the musk consumption in world (Homes, 1999).

Convention on International Trade of Endangered Wild Fauna and Flora (CITES) is a treaty for control the international trade of endangered and threatened species. Since the creation of the CITES in Washington, D.C. in 1976, the CITES has become one of the most successful international environmental treaties (Wijnstekers, 2001). Musk deer populations in India, Nepal and Bhutan have been included in the CITES Appendix I while the rest of musk populations have been listed in Appendix II. The 11th COP of CITES passed Res. 11.7, which urges all parties, particularly musk deer range and consuming countries and those through which musk deer specimens pass in transit, to immediate action in order to reduce demonstrably the illegal trade in musk deriving from wild musk deer. Such resolution was address to the CITES authorities of China:

"The Authority of China should suspend exports of specimens of *Moschus* spp., excluding derivatives, until they have provided the following information to the Secretariat:

- available data on population status and trends;
- field research programmes;
- details of measures taken to control harvests;
- the sources of musk used for manufacture of medicines;
- the measures in place (e.g. licensing, record-keeping, etc.) to control the manufacture of products containing musk or musk derivatives; and

- production from captive stocks."

The 16th Animals Committee meeting at Sharphies Town, USA also urged an assessment of musk markets in China. A proposal of conducting a musk market survey was initiated at this meeting. Previously, a market survey on traditional Chinese medicine was carried out in 1996 by the Endangered Species Scientific Commission of the People's Republic of China (ESSC). However, no musk market has been carried out since then. Therefore, the ESSC proposed a TCM market investigation aiming at musk consumption in TCM. The chief investigator signed a contract with the CITES Secretariat in June 2001.

To carry out a market survey on musk market is important for assessing the consumption of the musk in the Chinese markets. Particularly, such musk market survey will reveal some important factors in TCM market. The information could be used to estimate international treat of musk and products that use musk. Such a survey will also shed some lights on the use of musk substitutes, what is so called synthetic musk, in the TCM industry in China. The historic musk trade data will be reviewed and analyzed. These statistics will serve as the base for estimating wild musk population, and ultimately to estimate of musk production in China. Thus, we could determine the role of China in the musk deer conservation of the world.

Reviews of the background information

Biology of musk deer

Musk deer are shy animals dwell in natural forests. Different musk deer species may differ in food habits and territory size due to different habitat types. Musk deer are small size deer-like animals, take the forest deer for an example, its body length is about 70~80cm, shoulder height is about 50cm, and its body weight is about 20 kg (Feng *et al.*, 1986). Male musk deer possess no antlers but have exaggerated and protruding canines.

Taxonomy

Taxonomy of the musk deer is a disputing issue among zoologists, however, it is generally agreed that all musk deer are belong to a single genus *Moschus*. Although some scientists separate the musk deer from the deer family, Cervidae, to a separate family, Moschudae (Whitehead, 1972; Groves and Grubb, 1987; Sheng *et al.*, 1992), it is most recognized that the musk deer form a single family Cervidae with other deer in China (Zhang, 1997). But the taxonomists have not agreed yet how many species there are within the genus, *Moschus* (Flerov, 1930, 1952; Allen, 1940; Gao, 1963, 1986, 1987; Cai and Feng, 1981; Li, 1981; Green, 1986; Scott, 1987; Groves and Feng, 1986; Groves, 1995; Geist, 1998). Commonly, Chinese researchers recognize five musk deer species, they are the Siberian musk deer *Moschus moschiferus* (Mm), the forest musk deer *M. berezovskii* (Mb), the alpine musk deer *M. sifanicus* (Ms), the black musk deer *M. fuscus* (Mf) and the Himalayan musk deer *M. Chrysogaster* (Mc) (Zhang, 1997). But some researchers claimed there is only one species in *Moschus* (Gao, 1963). Recently, Li *et al.* (1999) reported a new musk deer, the Anhui musk deer, *M. Anhui*, which lives in the Anhui Province in the east China according to mitochondria DNA data. Thus, Li *et al.* claimed now there are six musk deer in China. In this report, we still use the five musk deer taxonomic system: Siberian musk deer, forest musk deer, alpine musk deer, black musk deer and Himalayan musk deer.

Distribution

The distribution range of musk deer in China is located between 80°~140°E and 20°~72° N, which extends from the Palearctic Realm to Oriental Realm. *Siberian musk deer* mainly exists in the Heilongjiang, Jilin, Liaolin, Hebei, Neimonggu and Shanxi provinces in China. *Forest musk deer* distributes in the provinces of Henan, Shaanxi, Sichuan, Guizhou, Yunnan, Hunan, Hubei, Gansu, Qinghai, Guangdong and Tibet, Guangxi autonomous regions. *Alpine musk deer* is found in Ningxia Hui Autonomous Region, the provinces of Shaanxi, Qinghai, Gansu, Sichuan, Yunnan and Tibet (Zeng and Pi 1984; Cai, 1989). *Himalayan musk deer* has an extremely narrow range along

the Sino-Nepal Border. The Himalayan musk deer is dark brawn, about the same size of alpine musk deer. Black musk deer is black brawn, smaller than alpine musk deer, is only distributed in humid canyons with dense forests of 3,000~4,400m in east Himalayan and southeast Hengduan Mountain. (Figure 1; Liu *et al.*, 1996; Zhang, 1998). Both Himalayan and black musk deer have small population sizes (Liu *et al.*, 1996).

Habitat

All species of musk deer inhabit in forests and high shrubs, with an altitude ranges from low land to mountainsides up to 5,000 m, regardless of evergreen vegetation, deciduous forests or broadleaved and deciduous mixed forest. The musk deer adapt most wildwoods well (Sheng *et al.*, 1992, Liu *et al.*, 1996). Forest musk deer prefers

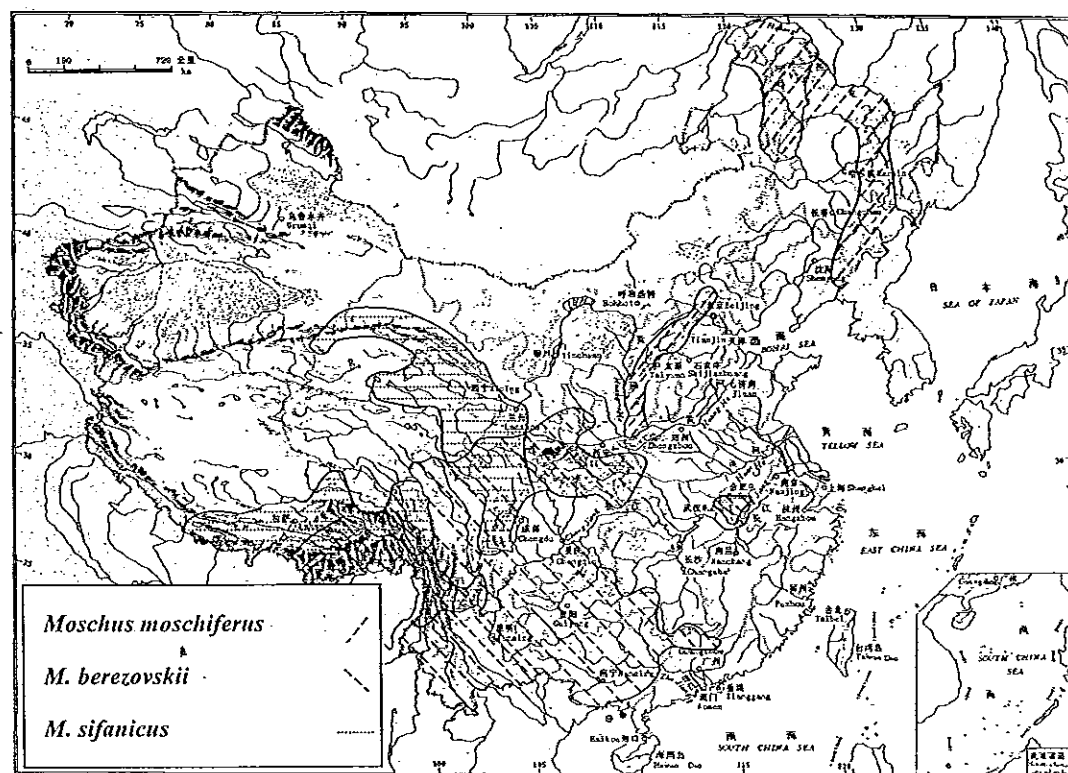


Figure 1 Distribution of musk deer in China (modified from Zhang, 1998)

matured broadleaved and coniferous mixed woods (Hu, 1994). The musk deer also inhabit in steppe, Alpine shrubs and even bared rocks with little vegetation in Tibet

(Liu *et al.*, 1996). However, the habitats with high musk deer density are the broadleaved and deciduous mixed forests, alpine shrubs and sub-alpine dark needle leaved forests (Zeng and Pi, 1979; Yan, 1979). Liu *et al.* (1996) reported population density of 8.7 musk deer on per square kilometer in broadleaved and deciduous mixed forests, 4.1 in dark needle leaved forests, and 1.4 in the alpine shrub and meadow.

Musk deer are territorial animals (Sheng *et al.*, 1990). Territory size for males ranged from 25.5~ 35.5 hm^2 during non-breeding seasons, increased to 41.71~47.17 hm^2 during breeding season, for females, 28.95 hm^2 during non-breeding seasons, 40.76 hm^2 during breeding seasons (Yang *et al.*, 1996). The home range of musk deer varies from 3~300 ha in species and seasons. (Green, 1982 and Heng *et al.*, 1992).

Food habits

Food habit of musk deer varied by seasons (Green, 1987, Hu, 1994, Liu *et al.*, 1996). Musk deer are browsers. In Tibet, they feed on 1,740 plant species of 170 genera and more than 70 families according the microscopy of the rumen contents of poached musk deer (Liu *et al.* 1996). The musk deer feed on leaves of trees, shrubs and grasses. Moss, lichen and fungus also make a considerable portion of their diets. Musk deer like to ingest tender leaves and buds of shrubs, followed by forbs, but they eat little grasses during summers (Yang, *et al.*, 1990, Hu, 1994, Liu *et al.*, 1996).

Reproduction

The period from October to February next year is the reproductive season of forest musk deer. Pregnancy lasts about six months in female musk deer. Normally, the females give birth of 1-2 calves. Twins are common. The juveniles mature at one and half years old. The recorded longest longevity of musk deer in captivity was 20 years, but generally the longevity of musk deer is about 15 years (Sheng *et al.*, 1992 and Wang, 1984). Siberian musk deer reproduces from October to next February, occasionally the Siberian musk deer produces triple fawns. Pregnancy period in

Siberian musk deer is also about 6 months. Zeng (1991) reported the pregnancy rate in alpine musk deer was 76.92%, the surviving rate of juvenile alpine musk deer was 80% and mature at the age of two-year-old. The longevity of Siberian musk deer is about 17 years (Sheng, *et al.*, 1999).

Zeng *et al.* (1984) reported annual growth rate of forest musk deer was 30.4%. However, because twins are as high as 80% (Bi, *et al.*, 1981; Sichuan Musk Deer Breeding Research Institute, 1988), annual growth rate in musk deer may as high as 50%, or even higher. The growth of musk deer is only constrained by available territory and foods if without human disturbance (Yang and Feng, 1998). Natural enemies of musk deer include lynx (*Lynx lynx*), golden cats (*Felis bengalensis*), wolves (*Canis lupus*) and red foxes (*Vulpes vulpes*). Some large birds of prey, such as *Aquila chrysaetos*, *A. rapax*, *Gyps himalayensis*, also kill musk deer fawns (Hu, 1999, Wang and Hu, 1994, Liu *et al.*, 1996).

Population status

Although musk was emphasized as a very important wild animal resource in China, the comprehensive census of the musk deer in wild had not been conducted before 1985. Those estimations made in different studies either through a convert of annual musk yield which presumably to the lower estimation, or by estimating the density and habitat area of musk deer (**Appendix 1** and **Table 1**). In 1993 the China Management Authority of CITES conducted a special survey on musk deer, and reported the number of musk deer in several provinces of China. At the end of last century, a survey of musk deer was conducted by the State Forestry Administration, but the result has not reported yet.

Since 1980s, there have been disputing opinions about status of musk deer population and musk resource, utilization, and trade in China. Some people think the musk deer populations are severely endangered and its habitats are fragmented; the commercial use of musk must be banned (Anon, 2001a). The resolutions which request to list all musk deer in CITES Appendix I has been suggested. Whilst some other

people think based on the wide utilizations, high demand and high value of musk, the musk deer are threatened severely. However, due to its extensive distribution and population status, the musk deer is not qualified for the criterion of CITES Appendix I yet.

During the 1990s, international trade in musk increased in a number of European countries, while the population density of musk deer in the range countries, such as Russia (former Soviet Union), Mongolia, China decreased rapidly. A dramatic event that caused sharp shrinking of wild musk deer populations is the change of hunting mode of musk deer in the early 1980s. Steel wire snares become a popular and efficient hunting means for massive trapping musk deer. Such a situation arose the attention of the international community and the Chinese wildlife management authority. Traffic Europe conducted a survey on the use of musk in the European perfume industry in 1999, Traffic Hong Kong carried out a survey on the musk deer farming in China in 2000. The Chinese wildlife management authority conducted a national wide survey of musk deer population statue during 1996-2000.

With their wide adaptation to various habitats, musk deer populations show a high variation in local densities, which range from 0.01 up to 51.00 /km² (**Table 1**). Generally musk deer has a normal density ranges from 1 to 10 /km² in their undisturbed habitats. The population density of musk deer lower than that range implies the high hunting pressure and habitat damage, but when the population density is higher than that range probably is due to the result of seasonal aggregation in high quality habitats.

Since the musk deer are widely distributed with relatively high population density in their habitats. It was speculated that in the past, the musk deer had a huge number before 1950s in China, some researchers estimated the habitats for musk deer were around 2,000,000 km² and with different densities (**Appendix I**). Many efforts were devoted to estimate the population size of the musk deer (**Table 2**). Based on the data available, the general trend of musk deer population in China could be assessed. The population size of musk deer decreased from 3,500,000 in 1950s to

1,000,000 in 1990s, then decreased to about 500,000 in 2000. Thus, in 46 years the musk deer population has decreased nearly 90% in China. The field survey data during the period of 1997 to 2000 from Chongqing, a region used to be a part of Sichuan Province before 1995, the forest musk deer density decreased to 0.2042/ha in the forested and shrub-lands (Deng, personal communication). Thus such a low population density actually means the musk deer populations are economic extinct in some areas (Jiang, 2001).

Table 1 Musk deer densities reported in various locations

Species	Density (deer/km ²)	Year	Location
Siberian musk deer	0.01	1984	Forested regions in northeast China (Sheng, 1998a)
	0.10-0.36	1995	Dabieshan Mountain, Anhui Province (Sheng, 1998a)
Forest musk deer	0.3-7.29	1986	Northwest Sichuan Province (Sheng, 1998b)
	0.7-9.15	1989	Baiyu County, Sichuan Province (Yang et al., 1989)
	1.43	1995	Mianning County, Sichuan Province (Guo & Hu, 1998)
Alpine musk deer	3.7-10.2	1982	Huangnan, Qinghai Province (Sheng, 1998c)
	23-51	1994	Xinglongshan, Gansu Province (Sheng, 1998c)
	7.4-20.4	1973	Huangnan, Qinghai Province (Yang & Feng, 1998)
	* 1.55-1.86	1996	Changdu, Tibet (Liu et al., 1998)

Since late 1970s, the demands for musk have been soaring due to high price in international market. During 1960s, one musk sac was priced only several Yuan RMB in China, but the price of musk sac is now 2,000 Yuan RMB, but the price of musk in international market is several times that of gold (Yang and Feng, 1998). The huge gap between domestic and international markets stimulated the musk deer

poaching and musk smuggling. China is undertaking stricter measures on the trade of wildlife species than what CITES requires. The legal exportation of the musk has been under firm control of the Chinese CITES Authorities since China became a party of the CITES, but poach and channels of smuggling of musk may long exist before the CITES. Though musk deer are state-protected wildlife, its extensive distribution makes law enforcement extremely difficult.

Liu *et al.*, (1998) reported there were about 230,000 musk deer in Tibet at the end of 1980s. The average harvest of musk deer by hunting was 7,200 annually in Tibet. If the musk population grew at a rate of 30.7%, 70,610 musk deer would be added to 230,000 musk deer stock population annually. The National Endangered Species Import and Export Management Office of the People's Republic of China (1999) publicized census of musk deer in some provinces and autonomous regions in China. According to their survey, there were 105,000 musk deer in Tibet Autonomous Region, 5,100 in Qinghai Province, 11,390 in the Inner Mongolia Autonomous Region, 55,414 in Gansu Province, 5,026 in Heilongjiang Province, 4,191 in Henan Province, 171 in Guangxi Province. The differences in the population density of musk deer in Tibet was dramatic, the National Endangered Species Import and Export Management Office's estimates were only about half of that of Liu *et al.* (1996). However, the report of the National Endangered Species Import and Export Management Office did not give the estimations of the musk deer populations in Sichuan Province and Yunnan Province, which are major musk producing provinces in the history. If we take average musk deer population size in the all the reported provinces outside Tibet times 22, the number of musk deer range provinces, then the musk deer in China were not less than 500,000. Consider the similarities of hunting pressure and in geography, based on the musk productions in Sichuan, Yunnan, Qinghai, and Shaanxi provinces (**Table 2**), we estimated there were 400,000 musk deer in Sichuan, Yunnan, Qinghai, and Shaanxi provinces in early 1990s, then China had at least 600,000 musk deer in the early 1990s.

According to the data publicized by the Information Center of China National

Corporation of Traditional & Herbal Medicine (2001), the average annual production of musk in China from 1980 to 1986 was 3,400kg (**Figure 2**). According to Liu (1996), killing a musk deer in the field, regardless age and sex, can averagely harvest 5 grams musk. Then we need a musk deer stock of at least 3,400,000 with annual population growth rate of 20% or 2,300,000 with growth rate 30% to maintain such a musk production output. Assuming half of the musk sacs were adulterated, we need at least 1,000,000 to 1,700,000 musk deer for maintaining such a scale of musk production in China during that period.

To combine the two analyses, it is acceptable to estimate that China had at least 1,000,000 musk deer in 1990s. As the references indicated that musk deer population declined and musk production decreased during the periods indicated in **Table 2**, there may be due to inaccessible conditions in research sites, most of wildlife surveys were not conducted in remote regions, but in those regions with high hunting pressure on musk deer. Nevertheless, musk deer populations in China have decreased dramatically with local extirpation (Ma *et al.*, 1987; Wang *et al.*, 1987; Wang and Sheng, 1988; Sheng, 1991; Li and Jiang, 1993; Peng, 1993; Yang, 1993; Wang, 1998; Li, 1999; Liu *et al.*, 2000a, 2000b; Wang *et al.*, 2000).

Main causes of population decrease

Musk deer in China are threatened or endangered (Wang *et al.*, 2000). Deforestation plus large-scale poaching cause the distribution and populations of musk deer to decrease; thus threaten the survival of these species.

Destruction of natural habitats

Habitat loss is a general factor for all forest dwelling animals, including musk deer (Cheng, 1993). It was estimated that original habitat area of musk deer was as large as 2,000,000 square kilometers, which decreased greatly. Many wildwoods of musk deer formerly inhabited had disappeared in 1990s (Yang and Feng, 1998, Jiang, 2001). Natural forests were logged national wide until the starting of the Natural Forest

Protection Project in 2000. According to Chen *et al.* (1998), national forest surveys revealed that logging caused the log storage in the natural forests reduced 4.44% annually before 1989. 33% of the clear-cut forested area became bare-grounds without trees. During the period of 1981~1988, the area of matured forests reduced 1/3, only accounted for 18% of forested area (Tao, 1994). Forest fires burned down 12,660 hm² forests in 1990, 22,200 hm² in 1991, which were about 0.01~0.017% of the total forested area of China, respectively. It takes 10~15 years of natural succession for those fire-burned forests to become suitable habitat for musk deer again. Forest insect pests also damaged a considerable portion of forests. During the period of the 1985~1990, insects pests damaged 214 times forested areas as much as that were burned down by fires during the same period (Chen, *et al.*, 1998). Furthermore, acid rain that caused by air pollution also killed trees, according to the statistics of 1994, 15,000 hm² forests were killed and 40 hm² were severely damaged by acid rains in Sichuan, Guizhou, Guangdong and Guangxi provinces alone. All these factors in combination, reduced the natural habitats of musk deer at a rate of 5% annually before 2000 (Jiang, 2001).

Poaching

Before the end of 1970s, the main tools for hunting musk deer were hunting guns, pit traps and dogs (Maerkang Musk Deer Farm, Animal Group of Department Biology and Sichuan University, 1974; Xiang, 1974). Though the sale and use of musk in TCM is under the strict control of the State, the domestic and international demands for musk cause severe poach pressure on musk deer. The State started to control the firearms including hunting guns in the country in 1980s, the firearms in some remote areas were also required to handed out by the police authorities in the 1990s. Such measures greatly reduced poaching of musk deer with hunting guns.

Since 1980s, steel wire snares have being used to hunt musk deer national wide by the poachers. With little time, labor, and at low risk, snares can be set up easily and in high densities. What make the things worse is that snares catch all musk deer

regardless their sex and age (Yang *et al.*, 1989). At the mean time, China started her economy reform, loosened the state control of economy in many ways and opened up to the outside world. The price of musk in black market increased rapidly during the period, for example, a musk sac was for several Yuan RMB in black market of Tibet, the price increased hundred of times in 10 years (Liu *et al.*, 1996). The high demands intensified the poaching of musk deer, with a desire to get quick fortune in local people. Although under the regulation of Wildlife Protection Law, musk deer are species of Category II State Protected Wildlife Species, hunters are required to grant permits by the wildlife management authority of provincial government to hunt musk deer.

Since late 1980s, China has strengthened the wildlife protection law enforcement, poaching of wild animal is decreasing in some areas. However, with the lure of huge profit in musk trade, the poaching of musk deer was still a quite serious problem in the remote areas. From 1988 to 1999, in an protected natural reserve of 200 km², 37,900 snares were found and removed, and 536 alpine musk deer trapped by snares were found dead, where the number of alpine musk deer decreased form about 5,000 in 1993 to about 1,000 in 2000 (Anon, 2001b). The local wildlife management authorities of the Tibetan Autonomous Region confiscated more than 380,000 steel wire snares and about 500 hunting guns or other hunting equipment during the period from 1989 to 1994 (Table 2). The density of steel wire snares was so high in some areas that not even musk deer, sometimes, pheasants, domestic animals such as sheep and cattle were trapped.

Musk and its uses

The Musk

Musk gland is a sac inside the foreskin of male musk deer (Bi, *et al.*, 1980; Feng, *et al.*, 1981; Figure 2). The musk is a mixture of tens of chemicals (Sheng *et al.*, 1992) and excreted from the gland cells, and the mixture remains in the bursa for 2-3 months to transform into real musk (Sheng *et al.*, 1984; Rui *et al.*, 1984; Ying, 1990). The male musk

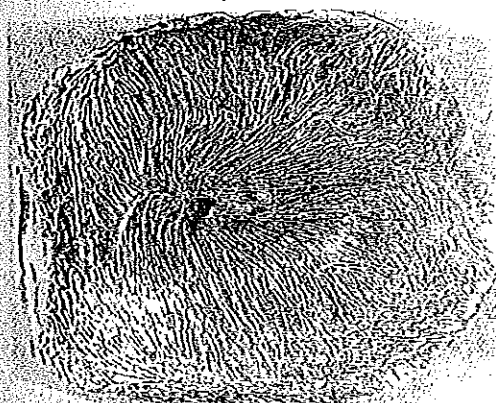


Figure 2 Musk sac

deer start to secrete musk at the age of one and half years old, peak musk secretion ages are 3-10 years age (Dai and Yin 1991). Each year, from May to July is the musk secretion season. The males can produce musk for 18 years in captivity with an average 7g annual production per male (Yan *et al.*, 1981; Wang and Huang, 1981; Yan, 1978). Parry-Jones and Wu (2001) estimated

Table 2 The Steel wire snares, hunting guns and musk sac or skins confiscated by the local wildlife management authorities in the Tibet Autonomous Region during 1989~1994 (Source, Liu *et al.* 1996).

Region	Year	Steel wire snares	Hunting gun	Other hunting equipments	Musk sacs	Musk skins
Gongbujiangda county	1989	20,423		19		
Lang County	1989	13,000		12	20	200
Rikazhe District	1990~93	14,2000	6	78		
Leiwuqi County	1993	300	3	17		
Jiali County	1993	>1,000	3	23		
Changdu District	1989~93	>10,000	6	62	2	43
Changdu County	1991~92	62800	2	19		
Naqu District	1993	>10,000			21	92
Jiangda County	1990~92	30,000		26	8	
Millin County	1994	30,000		39		5
Gongbujiangda county	1994	3,500		27		
Shannan District	1994	8,500	3	63		
Zuogong County	1993~94	3,000		44		
Lingzhi District	1994	30,000			2	4
Longzi County	1994	15,780	41			
Total		>380,303	64	429	53	344

annual musk productivity of about 12 g in captive musk deer. Which is likely to only occur in the males at the ages of peak musk secretion. For the wild deer, musk sac weight averages 15 -25 grams (Green, 1989 and Liu *et al.*, 1996, Yang and Feng, 1998). However, there are individual variations as well as species differences in the musk sac weights. The average musk sac weight also decreased in recent years. Yang and Feng (1998) reported that the average weight of musk sac purchased by the Tibetan Corporation of Traditional and Herbal Medicine decreased from 26 g in 1961 to 17 g in 1993.

Sheng *et al.* (1992) summarized the musk chemical components. There are six ketones, 15 steroids, proteins, peptides, amino acids, alcohols, esters, waxes, inorganic salts, and some other chemicals in musk.

Uses of musk

One user of musk is the perfume industry, but China is not a perfume producer; the amount musk used for making perfume is very small. However, during recent years, some products, such as toilet water, toothpaste, soap claim to have musk derivative as an ingredient are made and supplied to market. According to investigation, only few of those products really contain musk, indeed, most of them only contain synthetic musk for the flavor.

High-grade incense and joss sticks use musk. Some high-grade solid Chinese ink, which is one of the "Four treasures in the Chinese studio ", also used to contain small quantity of musk. But nowadays, solid Chinese ink is not popularly used as before. It was recorded when the paperhanger mounted Chinese paintings, they would also use little musk in the starch paste for antiseptis. But such a practice is not common any more. It was also reported that some high-grade snuff contained small quantity of musk as well. Nevertheless, all those musk consumption, if are not ceased, then they are small musk consumers compared with the use of musk in TCM (Figure 3).

Since 200 BC musk indispensably has been an ingredient in TCM, in which 295 prescriptions, 398 medicines (Cheng, 2000) and at least 86 proved unofficial recipes contain musk (The Information Center of China National Corporation of Traditional & Herbal Medicine, 2001). During a period of more



Figure 3 Traditional Chinese medicine that contains musk derivative.

than 2,000 years, TCM prescribed musk as a specific ingredient to cure fever, unconsciousness, swelling, pain, apoplexy, blocking of the respiration system, obstruction of the circulation of vital energy, sudden coma, amenorrhoea, dystocia, inflammation, and dulling (Huang, 2001). Since the 8th century, musk is also widely in use in traditional Tibetan medicine (Liu et al., 1996).

Production and trade musk in China

The musk producing regions in China

The main musk producing regions in China are the southeast Tibetan Plateau and northeast China (Figure 4). The production in northeast China is drying in recent years. Only the Tibetan Autonomous Region, Sichuan Province, Yunnan Province, Hubei Province, Qinghai Province and Gansu Province are the main musk producing regions (Information Center of China National Corporation of Traditional & Herbal Medicine, 2001). According the statistics of the National Corporation of Traditional & Herbal Medicine, the average annual musk pursued by the National Corporation of Traditional & Herbal Medicine during the 1980s was about 2000 kg, with a maximum quantity of about 7,000kg. The musk production in the Sichuan province accounted for about half of the national production, and from the Tibetan Autonomous Region accounted for about one third of the national

production. The third largest producer of musk in China is the Hubei Province, the fourth and fifth largest producers are Shaanxi Province and Qinghai Province, respectively (Figure 5).

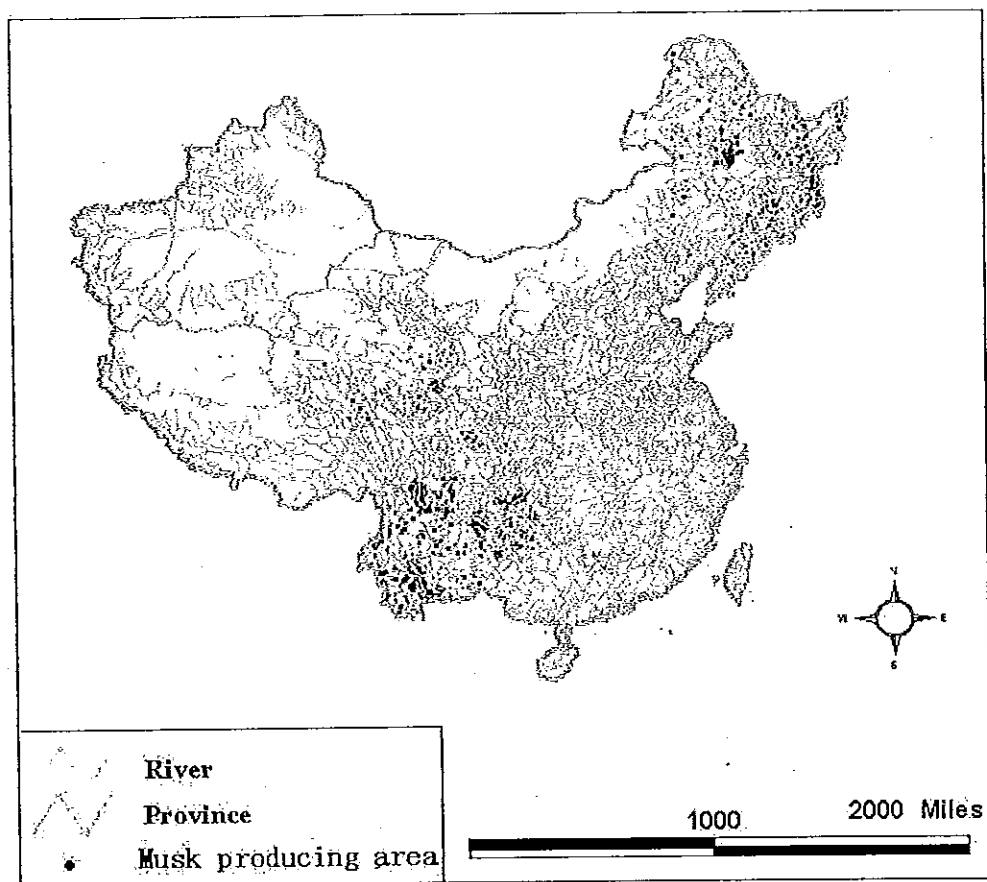


Figure 4 The main historic musk producing areas in China (Modified from Chinese Medicine Cooperation, 1996.)

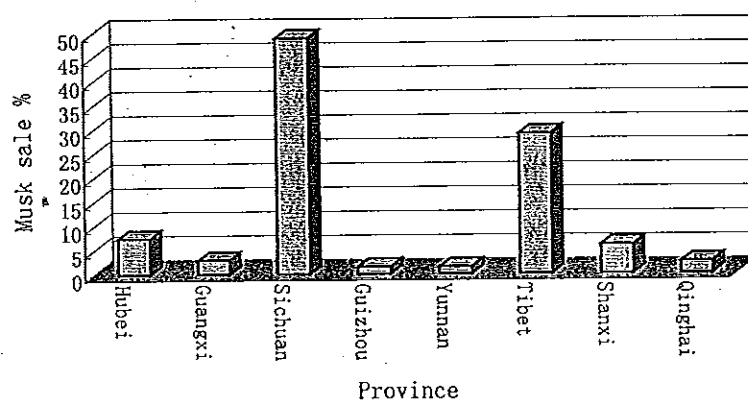


Figure 5 Shares of musk producing provinces autonomous regions in the total musk production in China.

Trade history

The musk resource and musk production in China account for about 70% of the world resource and production (Anon, 2001b). Long time ago, musk, like Chinese silk, china and tea, was important commodity for international trade. Compared with other commodities, musk is of small volume but high value, that is attracts little attention and is easy to carry. 100 AC, the Roman Empire traded musk with Tibet via the route Changdu—Lhasa—Rikazhe—Yecheng, what was so called the "Musk Road" (Anon, 2001d). United Kingdom, Russia and India all imported musk from China. As early as 17th century, the Eastern Indian Company traded musk from Tibet, Russia also traded musk from Tibet with the local products of Siberia in the 18th century. In the history, musk was one of the main commodities that Tibetan people traded for tea, sugar and textiles from other regions of China (Liu et al., 1996).

The musk trade system during past half a century in China

During the past half a century, China experienced deep social and economic transformations. A State planned economy system had been gradually established since 1949. Since then, the state planned economy dominated the national economy before 1982. All trades of traditional medicine materials were controlled by the State. An economic reform started in early 1980s, since the national economy has been transformed into a market economy. With a remarkable transit period between 1982~ 1985, the market economy system has been established in the country.

The musk trade system from 1949 to 1981

Before 1981, the China National Corporation of Traditional & Herbal Medicine, as the State owned and managed corporation monopolized the trade of raw TCM material overall the country by designated economic plan. The corporation had its network all over China. There were provincial corporations of traditional and herbal medicine in each province and cities, as well as in each district and county. Those corporations of traditional and herbal medicine in charge sale of raw materials for traditional

medicine and herbal medicine national wide. Those corporations purchased musk sacs from hunters and allocated the musk to designated TCM companies and manufacturers at rational price, to those TCM companies, the Corporation of Traditional and Herbal Medicine is the sole supplier of the and only legal trade channel of musk sale in China from 1949 to 1981. Except some musk was used by indigenous people, it was reported that 30% of the indigenous families have musk in stock in Tibet, which is used as remedy to treat illness (Liu *et al.*, 1996). The sale records of the corporation depicted the musk sale flows in China (Figure 6). During this period, all large-scale TCM companies were owned and managed by the State.

The musk trade system from 1982 to 1984

The period from 1981 to 1984 was the transit TCM market reform period. Since the economic reform started in China in early 1980s, the State has gradually opened up the sale of most of traditional and herbal medicine, except the trade of musk by unloosing the state control of the price of many raw materials of traditional and herbal medicine, but not including the musk. However, due to huge profits in the musk trade, more and more private merchandise have being illegally involved in the musk sale business. The musk sale network became diversified during the period. More and more musk had been channeled to private musk dealers because they offered much higher price for musk. The TCM companies also purchased musk from private musk dealers during the period. Hence, the musk sale records of the National Corporation of Traditional & Herbal Medicine no longer represented the true scale of musk sale in China since early 1980s.

The musk trade system from 1985 to present

The free market is finally formed during the period. During this period the State reformed the State owned TCM companies into the shared TCM companies. Generally, the employees of the TCM companies purchase the shares of their own companies in most of cases; shares of some of the TCM companies are traded in the domestic stock markets, but the State still hold most of the shares. The reform in the

Corporation of National Traditional & Herbal Medicine is also finished. Most of the local branches of the corporation have been privatized. The corporation is no longer a main channel of musk sale in China. However, the corporation still plays an

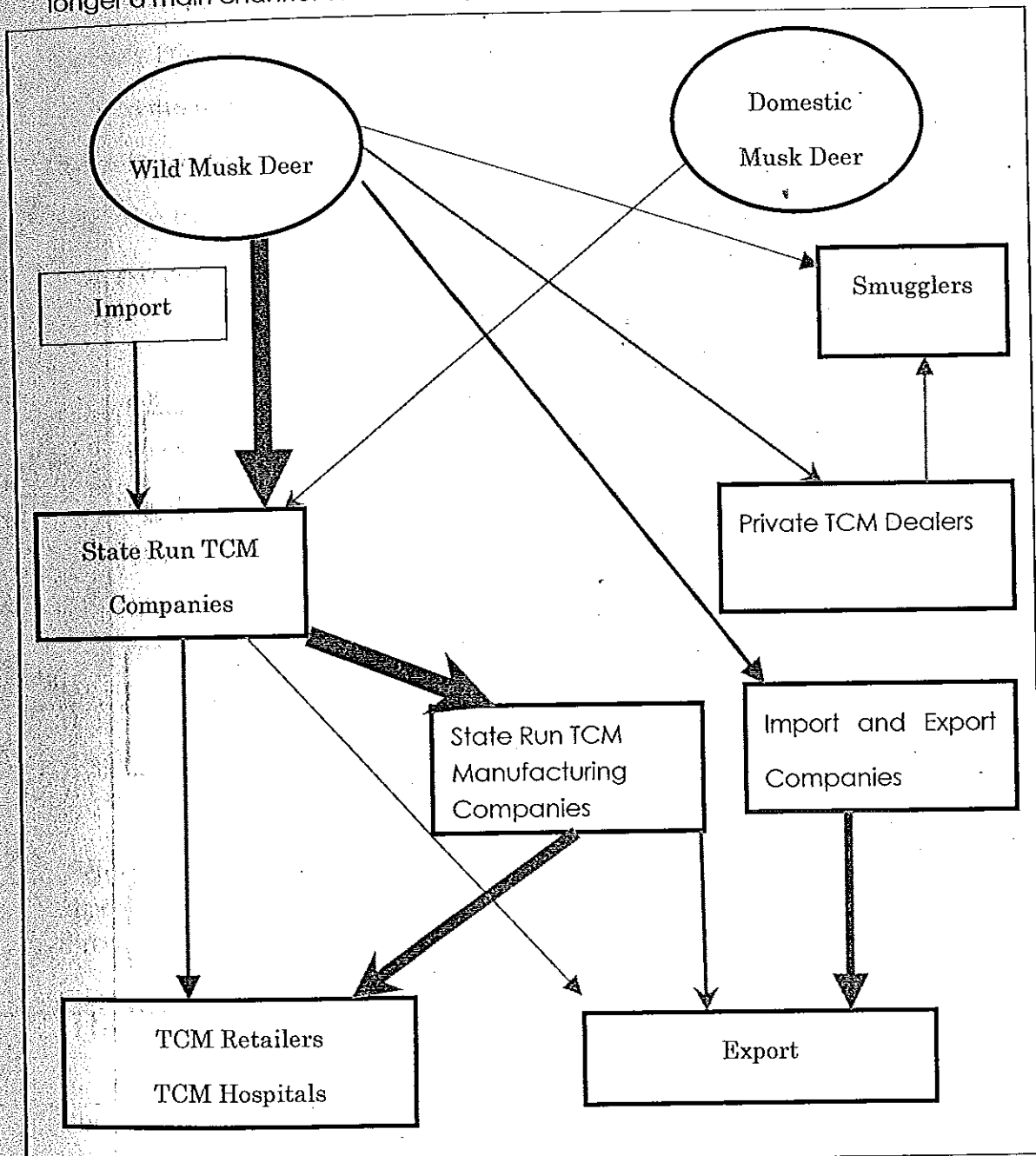


Figure 6 Musk sales from wild and domestic musk deer stocks in China before 1985. The musk sale system in China experiences three different periods: Period 1 the strict state control period from 1950 to 1982; Period 2, the transit TCM market reform periods, the TCM market had been transformed from the state planning market to a free economic market from 1982 to 1985; Period 3, the free economy TCM market from 1985 till now. Note the widths of the arrowed lines indicated the relative flow size.

influential role in the TCM research, information sharing, and trade of TCM. The corporation still allocates some musk; mostly from its musk in stock, to some key TCM companies to manufacture some key TCM products for the market. This is the only

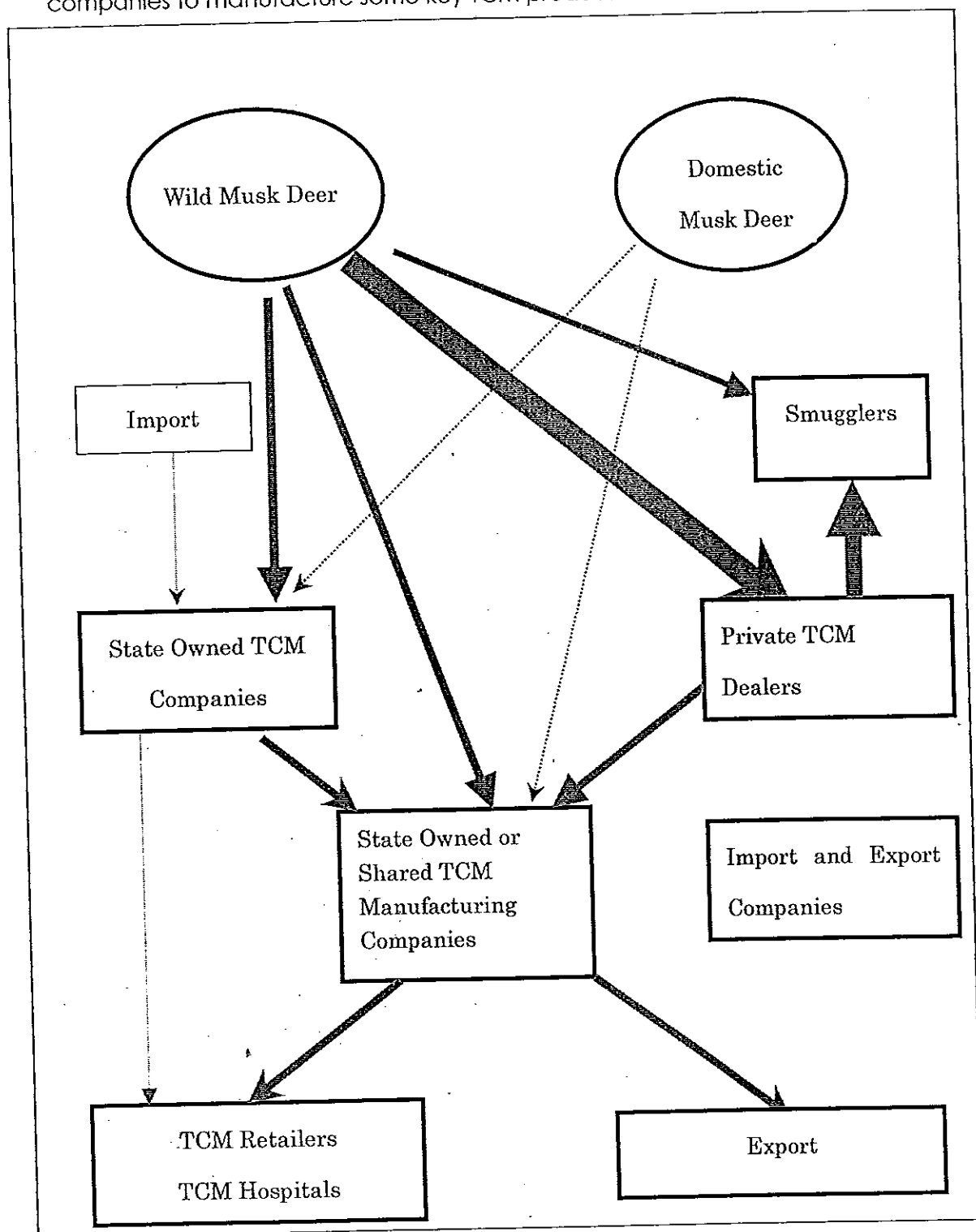


Figure 7 Musk sales from wild and domestic musk deer stocks in China after 1985.

legal channel of musk trade in China, but due to musk allocated by the corporation cannot maintain the rational production, those companies turn to the black market for musk supply (Figure 7). In Tibet, now more than 80% of musk is traded in black markets. Private musk dealers travel to remote villages to purchase musk, then sell the musk to the musk dealers in other parts of China or to musk dealers abroad (Liu et al., 1996). Since 1980, musk flows to the National Corporation of Traditional and Herbal Medicine at the County gradually diminished, as consequences of the competition from private musk dealers. Such trend can be seen in Figure 8.

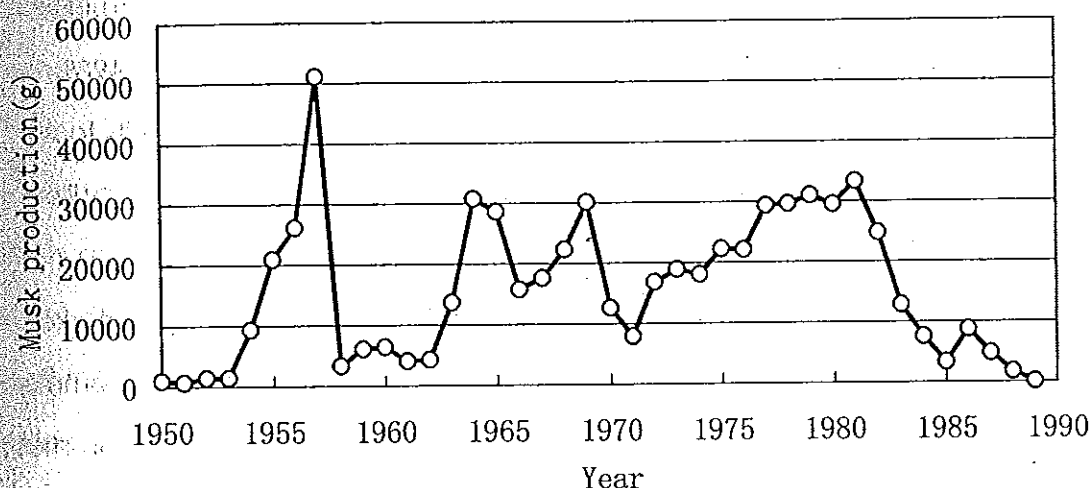


Figure 8 Musk purchased by the local traditional and herbal medicine corporations in Yichang, Zhigui, Badong, Xinshan counties of west Hubei Province during 1950~1990 (Source: Xiao, et al., 2000) .

The aims and objectives of the survey

The objectives of the musk market survey were: (1) To identify musk, that subject to significant use in major TCM markets, and to record the musk turnover in TCM markets; (2) To assess the annual volume of musk used by TCM manufacturers; (3) To project the sustainability of use of musk through analysis of market value, production fluctuations over time, annual domestic demand and supplies.

Musk deer is one of most concerned resource animals in China. Some Chinese traditional medicine doctors say they do not care much for the ban of using tiger

bone and rhino horns in the TCM because they hardly had some chance to prescribe tiger bones and rhino horns in their prescriptions, but the musk is a necessary ingredient used many prescriptions. However, due to most of the musk trades are under the table, there is no authorized data about its resource status, musk production, musk consumption and musk in storage, though these data are important base line information for solid management of musk trade and musk deer population. Sale and use of musk are very sensitive issues for the TCM corporations, musk retailers and consumers. They are often reluctant to answer or even to mention such kind of topics. Particularly, under current situation of mounting pressure on the illegal wildlife hunting and trade in China, to openly deal musk related business is offensive to the law. Since the Wildlife Protection law was put into effect in 1989, the Chinese Wildlife Authorities of the provincial level have not issued any permits to hunt musk deer for musk. From that time on any purchase and use of musk are illegal except tread of the musk in stock.

Due to above mentioned reasons; to carry out such a survey on the musk market is extremely difficult. Plus the adulteration of musk and musk sacs are common practice in the market, therefore, to obtain objective and accurate data on musk trade, if not impossible, need tremendous time and resource.

Despite of the difficult situation, ESSC still did its best to conduct the musk market survey within the very tight time budget. The results and findings are summarized below as base for CITES Secretariat, CITES parties, and Chinese government to take effective measures to control national and international trade of musk.

Methodology

Investigation methods

We conducted the musk market survey through the following avenues:

Traditional Chinese medicine market

Markets are good indicators of demand, supply and price of wild animal species in

TCM. A total of twenty-two TCM markets in 15 provinces and autonomous regions in China were quoted in *Medicine & Herbs Economic News* in 1996.

Based on the key musk producing regions in China, we visited the following TCM markets: Bozhou in Anhui Province (May, 2001), Yuzhou in Henan Province (May, 2001), Huanghe in Gansu Province (September, 2001), Yueyang and Shaodong in Hunan Province (Oct., 2001), Yulin in Guangxi Province (September, 2001), Qingping in Guangdong Province (September, 2001), Chengdu in Sichuan Province (August, 2001), Anguo in Hebei Province (March, 2002). Each of these markets was investigated once during this survey through visit and questionnaires.

And some TCM companies and drugstores were also visited in the cities of Lhasa, Rikazhe, Lanzhou, Yingchuan, Guangzhou, Guilin, Nanning, Chengdu, Chongqing, Kunming, Changsha, Yulin, Wuhan, Zhangzhou, Ningbo, Yichang, Beijing, Shanghai and Xiamen. Besides in these cities many small herbalist clinics, herb pitchmen, former hunters and local wildlife management authorities were investigated in Dali, Yiyang, Fengjie, Diqing, Zhongdian, Weixi, Yanlin, Changdu, Linzhi and Dujiangyan. We also visited local TCM pharmacies, local market, local wildlife management authorities and local people to investigate the musk trade in Dali, Yunnan Province (May, 2001), Yiyang, Hunan Province (Oct. 2001), Fengjie County, Chongqing City (August, 2001), Diqing, Zhongdian, and Weixi in the Yunnan Province (August, 2001), and Yanling County, Hunan Province (September, 2001), Changdu and Linzhi, east Tibet (October, 2001), and Dujiangyan City, Sichuan Province, the Lhasa and Rikazhe, south Tibet (January, 2002) (**Figure 9**). All the regions are historically important musk producing regions.

Investigation by correspondence

We designed five types of questionnaires (see **Appendices II~VII**), which are designated for wildlife management authority, TCM company, TCM pharmacy, TCM markets and musk deer breeding farms or institute, respectively. Number of musk deer farms, estimates of total number of musk deer and offspring reproduced in all

musk deer farms constituted the main questions of these questionnaires.

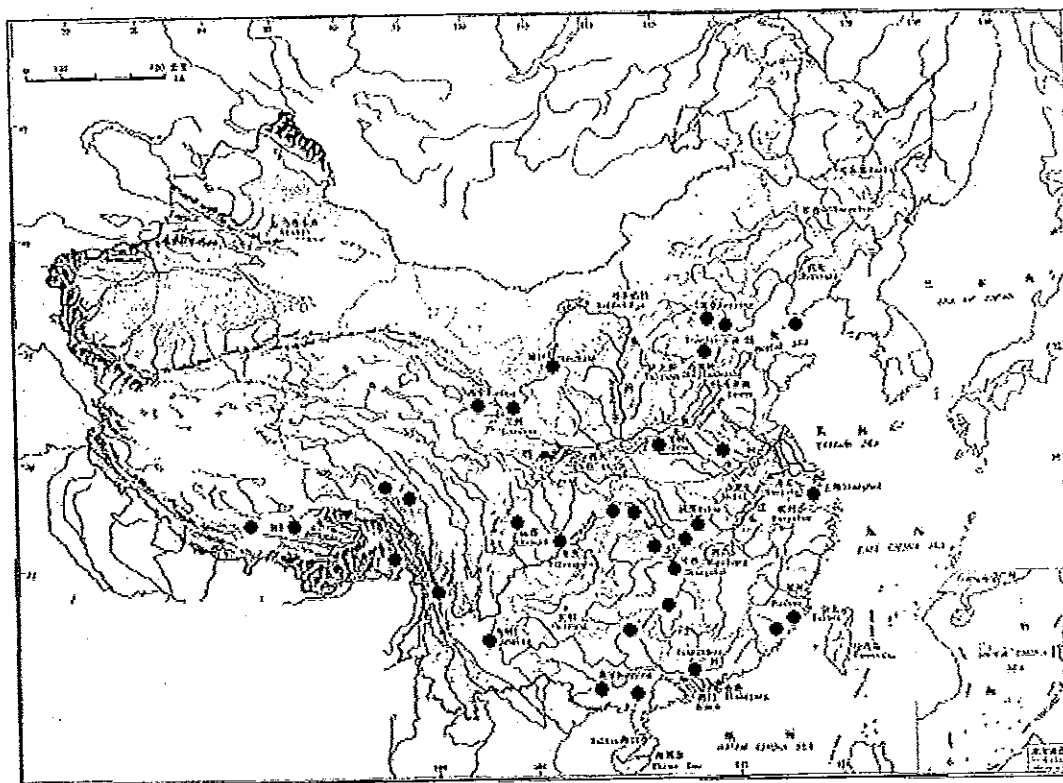


Figure 9 Surveyed cities and areas during this musk market survey in China.

Archive and information searching

We conducted thorough searches to collect all relevant materials on musk trade, musk deer biology, including published or unpublished information in books, scientific papers, newspaper, advertisements and Internet websites, as well as proceedings and manuscripts.

Participants.

Chief Investigator:

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Local helpers

Some local people were hired as assistants during the market survey.

Schedule

The musk market survey was initiated after the 16th CITES Animals Committee Meeting, formally launched after a contract was signed between the CITES Secretariat and Dr. Jiang Zhigang of the ESSC in June 2001. The survey lasted from June 2001 to March 2002. TCM market investigations and investigation by correspondences were conducted from July 2001 to February 2002. The investigators analyzed the survey data, collected questionnaires and wrote the drafty report from February 2002 to March 15, 2002. The final version of the musk market survey was presented to the CITES Secretariat at the end of March 2002.

Results

The survey of musk market was difficult work, because secrecy of the musk trade (See Postscript). The investigators worked hard during the limited time period. The main findings are summarized below:

Responses to the questionnaires

We altogether mailed out 958 questionnaires to TCM pharmacy companies, TCM companies, provincial wildlife management authorities and TCM markets all over China (Table 3). Despite of all efforts from the ESSC, only 379 questionnaires were answered and returned to the ESSC office. The returned rate of those questionnaires

was low in both TCM pharmacy sector and TCM company sector. Particularly, we only collected less than four per cent of the questionnaires we sent to the TCM companies national wide. For guarantee the quality of data, we visited three TCM pharmacies and six TCM companies. Even though, we had little feedback form the TCM pharmacy and TCM manufacture company, we finally consulted the TCM professionals about the quality of data. At the final stage we collected the information about artificial breeding of musk deer in the Beijing and Fujian in March 2002. Most of the provincial wildlife management authorities answered the questionnaires. We also had most TCM market questionnaires answered, because we made arrangements to send out and to collect the questionnaires. Due to the sensitivity of the musk trade and the promise we made during the investigation, the questionnaires, source of correspondence, and communication are kept anonymous in this report.

Table 3 Questionnaire sent out and the questionnaires answered and returned.

Type	Number of Questionnaire sent out	Number of Questionnaire Answered	Returned (%)	Number of Investigation Objects Visited and Verified
TCM Material Pharmacies	55	8	14.5	3
TCM Companies	335	13	3.9	9
Provincial Wildlife Management Authorities	30	20	66.7	2
TCM Markets	538	338	62.8	6

Musk deer farming

Since the first musk deer farm was established in 1958 (Sichuan Musk Deer Breeding Institute, 1988), the farming of musk deer has increased slowly during the period of almost a half century. In this survey, a questionnaire was sent to every provincial wildlife management authority. Of the 34 questionnaires sent out, twenty questionnaires were returned. Based on the information from these questionnaires

and the other resources, a relatively veracious statistics of farming musk deer is presented in Table 4. The total number of farmed musk deer is 2,145.

There was still unverified information that some small musk deer family farms exist at various remote locations (Xu and Zhou, 2000). Thus, a total number of musk deer for musk in captivity in China is estimated around 2,500 at the beginning of 2002.

In contrast to the successful farming of Sika deer, *Cervus nippon*, which has increased to over one hundred thousands animals in captivity from 1958 to 2000 (Xu and Zhou, 2000), the musk deer farming is developing so slowly that its future remains uncertain whether farming of musk deer could meet the market demands in next twenty years (Parry-Jones and Wu, 2001). The circumstance is due to the difficulty of taming musk deer and the low domestic market price during the past half of century.

Table 4 Statistics of musk deer farming in China

Location	Number of musk deer farms	Number of musk deer in captivity
Shanxi	2	12
Jilin	1	10
Shaanxi	16	200
Guangxi	1	12
Gansu	2	272
Shanghai	3	155
Sichuan	2	1372
Fujian	1	38
Beijing	1	74
Total	28	2145

Production in the past

Before 1980s, musk was a commodity that firmly controlled by the state. From the local to the central government, there were detailed records of sale and trade of

musk. We assess the musk production according to those sale and trade statistics (Figure 10). Since the economic reform, the State tried to strengthen the control of illegal musk trade. But due to opening of market and price, reform of economic system, the sale of musk is gradually out of the control; there is no reliable statistics of musk sale and trade. From 1983 to 1988, 399 kg musk sacs were produced in the Tibet Autonomous Region; the State owned companies only bought about 198 kg, half of the musk production (Liu *et al.*, 1996).

Figure 10 illustrates the trade of musk in China from 1956 to 1986. During that period, the buy and sale of musk, averaged 1,900 kg annually, the buy and sell controlled by the National Traditional and Herbal Medicine was nearly balanced. Of the musk trade during that period there were some imported musk. From 1956 to 1978, the musk production was fluctuated between 1000 ~2000 kg annually. If the indigenous people use about 10% of musk, then the annual production of musk was about 2,000 kg in China during 1956 to 1978.

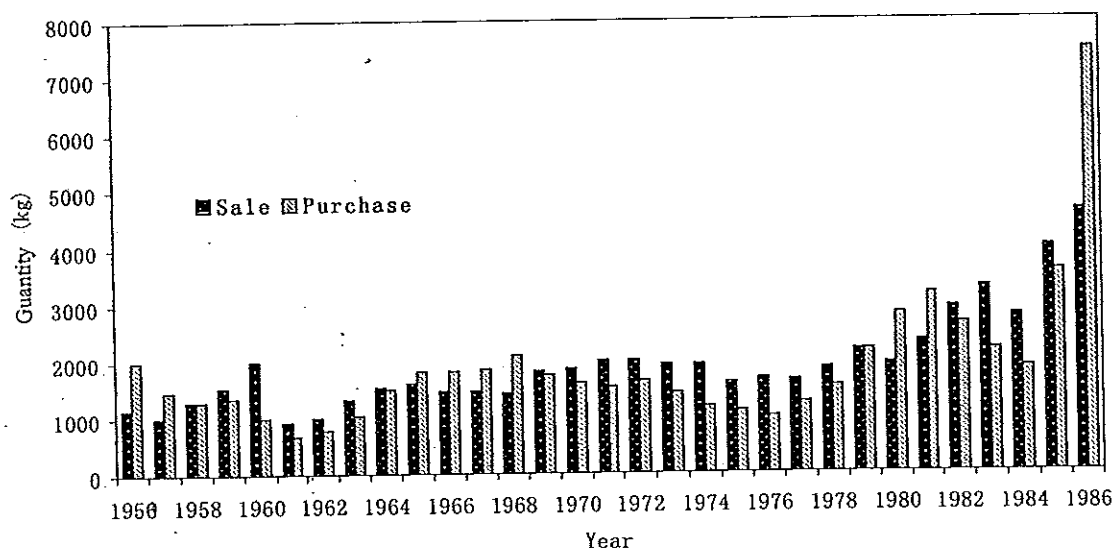


Figure 10 Musk trade records of National Corporation of Traditional & Herbal Medicine from 1956 to 1986 (adopted from the Information Center of China National Corporation of Traditional & Herbal Medicine, 2001)

There were discrepancies among the reports from different researchers. Compared with national musk production, there were large fluctuations in the trends of musk

production in different regions, with highest production in 1960s, not the 1980s. The musk production in China grew slowly until 1980s with some fluctuations.

Theoretically, to produce 2,000 kg musk, it needs to hunt over 400,000 musk deer. Based on the 25% annual population growth rate, a stock population of about 1.5 ~2 million musk deer is needed to maintain such

musk production. If we take the loss of habitat, decrease of musk deer population, and increase of musk production in the 1980s into consideration, the musk deer population size in the 1950s was even higher than 3 ~4 million musk deer or the musk deer had population increase rate higher than 25% during that time.

Present production

Because of trade in black market and lack of trade records, it is difficult to obtain the present musk production. We can only estimate the production according to limited information.

The musk purchased by TCM Company

The state run or the shared TCM manufacture companies used to obtain all their musk from the State run corporation of traditional and herbal medicine through the planned economy. Now, this channel of musk inflow to the TCM companies is greatly reduced. Thus, the TCM companies have to get supplementary musk from "free market" to make the ends meet, includes other local corporations of traditional and herbal medicine that have the permit to sale musk. The musk sac sale records of eight corporations of traditional and herbal medicine from 1996 to 2000, the maximum purchase was 400 kg, in the year of 2000, the minimum purchase was 150 kg, in the year of 1996 (**Figure 11**). The musk consumption in the TCM manufacturing companies is decreasing, compared with the annual purchase of 307kg by five TCM manufacturing companies reported by Guo et al. (1996). The traditional Tibetan medicine manufacturing companies in Tibet need 20 ~50 kg musk per year for making traditional Tibetan medicine (**Figure 12**). We estimated the annual musk trade

in these corporations of traditional and herbal medicine is about 500 kg. Therefore, to maintain such a musk production, it needs about 500, 000 musk deer stock population.

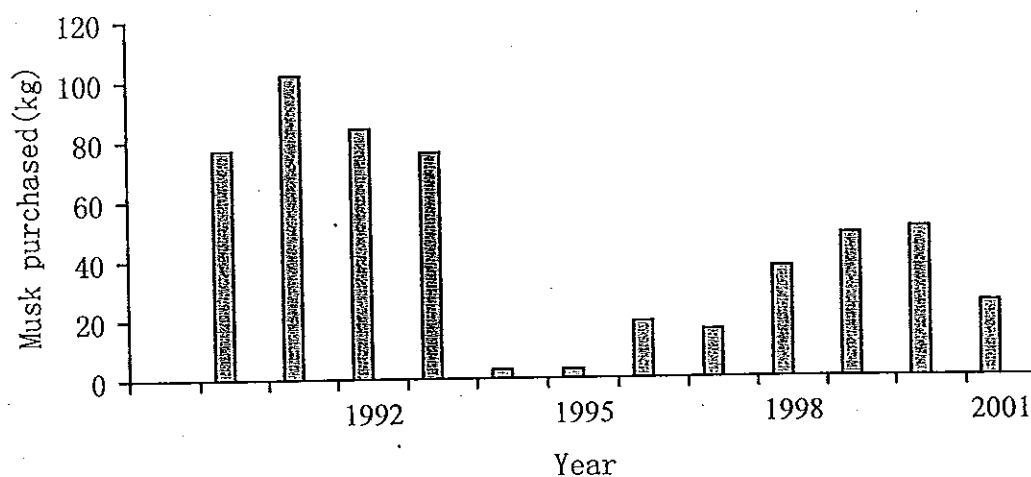


Figure 11 The average purchase of musk sacs by TCM manufacturing companies during 1990-2001. Data of 1990-1995 were from Guo *et al.* (1997) of five companies, the data of 1996-2001 were from this survey.

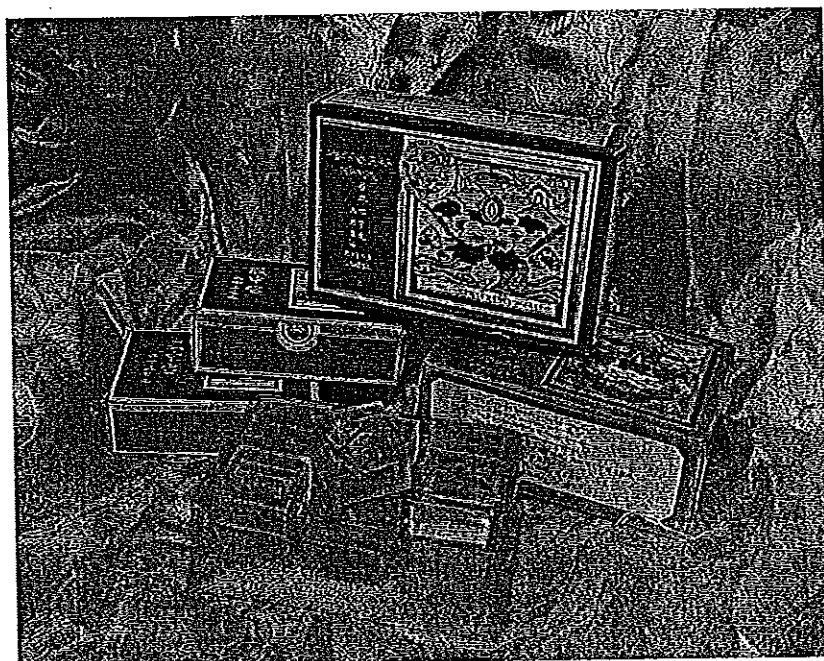


Figure 12 Traditional Tibetan medicines that contain musk derivatives.

Musk production from farmed musk deer

According to **Table 4**, if about one third of the captive bred male musk deer are able to produce musk and the musk production per male musk deer is 7 g per year, the 700 male musk deer can produce 4.9 kg musk. If we take some musk deer may farmed in other places than what indicate in the Table 4, the farmed musk deer can produce 5.95 kg musk.

Trade of musk in TCM market

Trade of musk by enterprises

The musk production and sale in China were in nearly balance from 1956 to 1986. Compared with 307 kg of musk sale by five TCM manufacturing companies reported by Guo *et al.* (1997), the average sale of 220 kg of musk by eight corporations of traditional and herbal medicines is decreasing. Because the musk sale volume in a corporation of traditional and herbal medicine is usually higher than the musk consumption in a TCM manufacturing company. The eight enterprises they also bought 28 kg of musk sacs through the rational musk sale from the National Corporation of Traditional & Herbal Medicine, except the musk sac trade from the markets. Annual trade of musk in the eight enterprises during the period: 288 kg bought in, 270 kg sold, and 17 kg in surplus and kept in storage.

Trade in the TCM markets

The 18 TCM markets were the keys objects of the TCM market survey. According to the 338 effective questionnaires, the trade of musk in those TCM markets was summarized in **Table 5**.

We verified 21 merchandisers in a TCM market, there were four merchandisers claimed they had musk for sale, which accounted for 19.05%, the quantity they can sale was 100~1,000g. Based on these investigations, the illegal trade of musk is not large. The following data can be used as circumstantial evidence, of the

merchandisers investigated, 77.51 percent of them knew that musk deer are state protected wildlife, 21.60% knew that state is not allow the individual merchandiser to trade musk.

Table 5 Trade of musk in those TCM markets from 1996 to 2001

Total sale (kg)	Musk in stock (kg)	Musk in the Markets (kg)
4.215	9.302	1.100

Table 6 summarizes the impression of the TCM merchandisers about the musk supply in the TCM markets. Form the 1980s, those TCM merchandisers who believed musk is still in sufficient supply decreased from 13% to 0.3% whereas those TCM merchandisers who thought musk is in short supply increased from 6.8% to 22.19%.

Table 6 Impressions of the TCM merchandisers about the musk supply in the TCM markets during different periods.

Impression of supply	1981-85	1986-90	1991-95	1996-2000	2001-
In sufficient supply	13.3%	1.8%	0.3%	0%	0.3%
In shortage	6.80%	8.88%	18.64%	20.41%	22.19%

Import and export

As the major producer of musk, China used to be the main supplier of musk to world. During 1930s ~1940s, the musk export form China accounted form about 70% of the world total export of musk (Information Center of China National Cooperation of Traditional & Herbal Medicine, 2001). The import and export of musk in China are summarized in **Table 7**. However, since 1989, China has stopped exporting musk, the small amount of musk trade internationally was from captive bred musk deer.

Estimation of musk in stock

The traditional and herbal medicine corporations and TCM manufacturing companies all have a large quantity of musk in story, because for a long time the

Table 7 Historical records of importing and exporting of musk in China

Year	Export (kg)	Reference
1973	73	Anon (2001f)
1980	180	Anon (2001f)
1981	240	Anon (2001f)
1982	228	Anon (2001f)
1983	222	Anon (2001f)
1995-2000	10	Anon (2001f)

musk was taken as strategically resource. Eight provincial level traditional and herbal corporations have about 150 kg musk in stock, average 19 kg musk each; thirty provincial level traditional and herbal corporations would have 1,140 kg musk in stock. The Yuling Municipal

Traditional and Herbal Medicine Corporation of the Guangxi Province has 1.5 kg musk in stock. The 300 district or municipal traditional and herbal corporations would have 4,50 kg musk in stock.

The 13 TCM manufacturing companies have 18 kg musk in stock, average each company has 1.38 kg musk in its warehouse. The 1,000 TCM manufacturing company would have 1,380 kg musk in stock. The TCM hospitals in China may have 1,000kg musk in stock. Thus, exclude the musk in the private hands; the musk in storage is about 4,000 kg in the country.

Scale of smuggling

Since 1980s, the musk smuggling in China has been increased rapidly. It is estimated that the level of musk smuggling has reached a level of 700 kg per year (Table 8). The driving force of musk smuggling is the price difference in domestic and international markets (Anon, 2001d, Yang and Feng, 1998). Since 1970s, the price in the international markets may be several times to almost 10 times higher in that in domestic markets (Table 9). About 70% of the musk produced in Tibet was smuggled (Liu et al., 1996).

Table 8 Records of musk smuggling

Year	Musk smuggled (kg)	References
1980	138	Sheng <i>et al.</i> (1992)
1981	173	Sheng <i>et al.</i> (1992)
1982	197	Sheng <i>et al.</i> (1992)
1983	223	Sheng <i>et al.</i> (1992)
1984	152	Sheng <i>et al.</i> (1992)
1985	97.5 *	Anon. (2001f)
1987	700	Wang (1993)
1990-	600-800	Anon. (2001c)
1996	280	Liu <i>et al.</i> , 1996
2000	705	Jiang, (2001)

* Record of January to June.

Table 9 Musk prices in the Chinese domestic and international markets
(Yuan RMB/g) *

Periods	Chinese domestic markets	Chinese black markets	International markets
1970s		5	
1980s	20	100	500
1990s	80-150		600
2000-	80-200	120-400	750

* Guo *et al.* (1997), Anon. (2001a), Anon. (2001c), Liu *et al.* (1996), Anon. (2001g)

Estimated musk production in China

Based on the above results, we give a general estimation of musk production in China. The estimated musk purchased through normal channel by corporations of traditional and herbal medicine is about 500 kg; about 80% of the musk is drained into the black markets (Liu *et al.*, 1996). Therefore, the total musk production is about 2,500 kg. Another estimation is the purchase by corporations of traditional and herbal medicine is about 500 kg plus the musk smuggled is about 700 kg in recent years, plus

about 10% of the musk production is held by the indigenous people, the total musk production is about 1,300 kg in China. Therefore, the estimated lower limit and upper limit of musk production in China is between 1,300 kg and 2,500kg.

Now adulteration of musk is a common practice (**Figure 13**), it was estimated the rate of adulteration of musk in trade is more than 50% (Anon, 2001a, Anon, 2001e). Liu *et al.* (1996) reported that musk adulteration was not common before 1980s because of the small scale of black market for musk during that period. Since 1980s, the black markets become the main channels of musk trade; adulteration has become a serious problem. First the hunter, the dealer may adulterate musk. The stuff used to adulterate genuine musk including liver, lung and feces of musk deer, synthetic musk, scent gland of Asian civet, even cheese, wheat flower, and starch. All musk samples that sent the Tibet Pharmacy Inspection Institute for inspection in 1993 were false; in 1994 over 60% of the musk samples were false. Enterprises determine whether to make a deal and how they will pay according to the musk contents in musk when trade musk. Take this factor into consideration, the lower limit and upper limit of the musk production in China is now between 750 kg and 1,250kg.

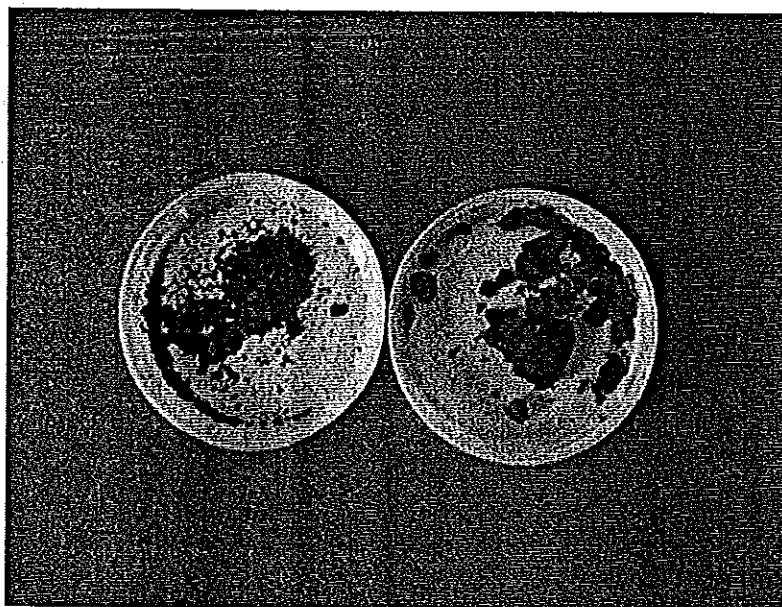


Figure 13 Real and false musk. The musk sample on the left is adulterated sample while musk sample on the right side is genuine musk from farmed musk deer.

Musk demands of the TCM companies

Of the TCM manufacturing companies answered the questionnaire, seven of 13 companies expressed their intention of continuing or restoring use of natural musk in manufacturing TCM if there is abundant musk supply. The predicted amount of the musk demand of individual TCM company varied between 500 to 25,000 g, the average demand was 1,000g. Thus, the demand of natural musk of the 1,000 TCM manufacturing companies national wide will be 1,000kg. The average musk consumption of TCM manufacturing companies in the 1980s varied between 3,000 ~5,000 kg. In the investigation, the demand for musk is greatly reduced. One of reasons is that it is a common practice in TCM industry to use synthetic musk due to the shortage of natural musk.

Estimation of musk consumption

TCM (including traditional medicine in Asia) is the major user of musk. In our survey, we found five out of the 13 TCM manufacture companies still use musk. The consumption was 47 kg per year; averagely each TCM manufacture company uses 9.4 kg (5~15 kg) musk. Of the 21 TCM prescriptions used by those investigated TCM companies, 11 still use natural musk. Thus taking 50% adulteration rate in musk, the total consumption of musk in 1,000 TCM manufacture companies could be 1,800 kg. But the annual purchase through legal channel is 500 kg. What makes the difference remains unclear. May be the musk adulteration rate is much higher than 50%, or the musk storages in those TCM manufacturing companies are in use.

There are six traditional Tibetan medicine companies in Tibet; all of them use musk to make traditional Tibetan medicine. Among those traditional Tibetan medicine companies, the largest one consumes about 5~12 kg musk per year, while the rest of the companies consume 2~6 kg musk each per year. All together, about 20~50 kg musk are needed for manufacturing traditional Tibet medicine annually.

Using of synthetic musk

Many TCM products claim contained musk in the markets actually only have synthetic musk or trace of musk. In the returned questionnaires, five of the thirteen TCM companies still use natural musk (38.5%), eight used synthetic musk (61.5%). Nine of the 21 TCMs manufactured the nine TCM manufacturing companies only contain natural musk, three TCMs contain both natural and synthetic musk. In 2000, total consumption of synthetic musk in the thirteen TCM companies was 160kg. The total annual consumption synthetic musk in China is more 1,000 kg (Anon, 2002a).

The attitude of TCM industry towards using synthetic musk in their TCM products is hastate and reluctant. Of the 18 TCM companies involved in the musk market survey, when asked whether they will clearly label their TCM products that it contains synthetic musk instead of natural musk, the answer "Yes" to the question was 22.2%, the answer "No" was 27.8%, while 50% of those companies did not say "Yes" or "No". The TCM that have musk ingredient are manufactured for overseas Chinese. In those markets, the TCM contains natural musk is of course more attractive and acceptable to consumers than those only contain synthetic musk.

Substitute for musk

In contrast to the situation in Europe, where the first incentive of developing synthetic musk was to search for less expensive substitute for natural musk (Piltz, 1997), in China the synthetic musk is made as replacement of natural musk in TCM. Though the effectiveness of synthetic musk is in disputing, among these substitutes of musk, only synthetic musk is commonly used in manufacturing TC, other substitutes such as, musk scents of muskrat (*Ondatra zibethica*) and oriental civet (*Viverra zibetha*) are still at the experimental stag.

Production value and employment

The number of employers in the 13 TCM companies was 6,027; average production

value per capital was 15,653 Yuan RMB yearly. The TCM products that contained natural musk were 1.12% of the total production value in those TCM companies. Averagely the production value of the TCM produced per kilogram natural musk was 340,000 Yuan RMB. The TCM products that contained synthetic musk were 9.34% of the total production value of those companies. Averagely the production value of the TCM produced per kilogram synthetic musk was 400,000 Yuan RMB. Production values of two kinds of musk of TCM products accounted for 10.46% of total production value of those TCM companies. Thus the production value of TCM that contains musk is not big share in the total TCM production value. However, as one of thousands of TCM raw materials in China, musk plays an important economic role. Judged by the jobs created by musk TCM industry, average 22 jobs are created per 1 kg musk used in the TCM industry. If we take TCM pharmacy, hospital and transportation and so on, more jobs may be created.

The production value per kg synthetic musk is slightly higher than that of natural musk, but take the adulteration of natural musk into consideration, which may as high as 50%, then the production value per "natural musk" is as high as 680,000 Yuan RMB/kg.

Discussion

Considering the status of musk deer populations in the field, strict measures of controlling both international and domestic trades, including listing the musk deer to Class I national protected wildlife as well as to CITES Appendix I, are under consideration. We analyze the following possible conservation measures:

Ban all uses of musk

Regardless the disputing opinion toward the wild musk population status, it is a common knowledge that the musk deer are threatened. Therefore, to ban all use of musk in TCM is one of measures that we should consider first.

Thinking about that synthetic musk is now in popular in use in the Chinese TCM industry, ban all use of natural musk in the TCM industry is feasible. But the TCM

Industry is still skeptical about the effectiveness of synthetic musk and the acceptance of consumers to synthetic musk. Some of TCM companies used synthetic musk in their products was due to shortage of natural musk and quality degradation of natural musk. Ban all use of musk means that TCM cannot have musk ingredients regardless whether the TCM product is labeled with musk or not. To take such a measure it will bring forward a shock to the TCM industry and the society. Because some TCM still use natural musk, which cannot be replaced with synthetic musk, ban using of musk means stopping production of those TCM.

There is evidence that smuggling is a major threat to the survival of musk deer. Musk deer live in remote, underdeveloped areas. The musk priced for 500,000 Yuan RMB/kg in the international markets, and price of 200,000 Yuan RMB/kg in the domestic black markets. To poach a gram of musk means 200 Yuan RMB income, in comparison that a farmer in the mountainous region who grow herb medicine can only make 224 Yuan RMB for a year. Thus the drive of poaching musk is mounting. If there is no other means of guarantee effectively ban all uses of musk in TCM and effective curb down the illegal international trade of musk. The ban may be just something on the paper that has no effects due the poaching and smuggling. The network of smuggling musk is now well in shape. Compared with the drug smuggling, musk smuggling is of far less risk but highly profitable. The trick thing is we do not where do the smuggled musk go, and who purchase those musk and for what purpose?

Trade with special concession

Actually, the trade of musk in China is still under special concession. Before 1980s, the trade of musk in China had been maintained at steady level (Figure 8) that meant the trade of musk with strict national concession was effective. However, whether we can or should restore the trade of musk with strict concession under the current political, economic and social circumstances is a problem that needs thorough exploitation.

Legislation

For alleviating pressure on wild musk deer population, we should adopt plausible measures such as elevating musk deer to Category I National Protected Wild Animal Species. The measure will allocate more resources and will tighten up the law enforcement for controlling illegal exploitation and illegal cross-board trade. Such a move will also provide legal ground of the law enforcement in crack down the musk deer poaching and black market of musk. Such an act will help the recovery of the musk deer and future sustainable use of musk resource following the Natural Forest Protection Project that already in effect.

To list all musk deer in CITES Appendix I is an option. Due to the importance of musk in TCM, to the health care of the people, such a move should be thoroughly thought over and discussed. We should assess all plausible impacts after banning use of musk in industry and commerce. We should make arrangement for substitute of musk.

Sustainable use

Musk deer are endemic to China. Now the National Forestry Agency issued a series of national forestry regulation, such as stopping logging in natural forests national wide, restoring forests on those farmed land that are not suitable for farming, such practices are helpful to restore natural habitat of musk deer (Jiang 2001). If we can find solution that we do not have to kill the musk deer but we can harvest musk from living musk deer, at the same time, the indigenous people and management receive benefits from the musk deer business, such operation will raise the consciousness of the indigenous people and local authority to protect the musk deer in their neighborhood. Only in such a way, the survival crisis of musk deer can be resolved from the root. The method of extracting musk from living musk deer can be try to use for collecting the musk dropped by musk deer in the wild.

Conclusions and Recommendations

The survival of musk deer in the fields is threatened. No matter how people are

disputing on the status of musk deer population and arguing why the musk deer are threatened. We should take action domestically and internationally at once to rescue the musk deer. On other hand, musk deer have extensive distribution ranges and relative high population growth rates. Musk has important culture, economic and social significances. Traditional medicine is important to the world population; the traditional medicine links millions and millions of people. Musk is one of the key ingredients of the TCM with irreplaceable effects. Whatever measure we are going to take in future, we should take a cautious step, fully assess the impacts on the live of people and make suitable arrangement. Synthetic musk is widely in use in TCM, but the synthetic musk cannot fully replace the natural musk in TCM. It may not offer effectively protection to musk deer to elevate the musk deer to CITES Appendix I, due to smuggling. Black market and smuggling are the most important threats to the survival of musk deer. Any proposed measure we are going to take, should effectively control musk black market and smuggling.

We would like to make the following recommendations:

To maintain the CITES Appendix II status for the musk deer populations in China whilst strength domestic and international trade control

The musk export with CITES permit was not the major part of the musk consumption in China (Anon, 2001). Even if the musk deer are all included in the CITES Appendix I, we still do not know whether such a measure can effectively curb down the musk smuggling and stopping all use of musk in TCM. If no other matching measures are taken simultaneously, such a move may stimulate the smuggling of musk. Under current circumstances, the effective measure is to improve the management of domestic trade and use of musk in China, and to get ride of the poaching of musk deer and illegal trade of musk.

To resolve the scientific, technological, economical, and management problems in the sustainable use of musk through extensive and effective international cooperation

The input to the scientific research and musk deer captive breeding is not enough to

match the importance of musk to the medical use, culture, and society in China. Except other reasons, the underdeveloped economy and the potency of its scientific ability may be the reasons. Therefore, to protect the musk deer, it needs the collaboration of the international society on resource monitoring, international and domestic trade monitoring and sustainable use of musk.

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Postscripts: Selected survey diaries

August 16, 2001. Wukuaishi TCM market in Chengdu

When we surveyed Lianhuachi TCM market in Chengdu, Sichuan on August 16, 2001. The TCM market had been moved to Wukuaishi in the same city. We went to there the second day. When asked several traditional and herbal medicine retailers if they have musk for sale, the answers were negative. However, the merchandise in the TCM shop said he could provide musk for sale to us. "Most of musk in the market are adulterated, the genuine musk sacs come from Tibet", the merchandise said. He said could provide as much as more than 10 kg musk sacs, if buyer does not need the official TCM certificate of genuine musk, the price is 70,000~80,000Yuan RMB/kg; if the buyer needs the official TCM certificate, the price is 150,000Yuan RMB/kg. The claimed musk dealer said there is a market underground for musk trade, many musk traders do not even have a shop due to the high pressure on illegal musk trade. "Many TCM manufacturing factories cannot buy in real musk, the genuine musk is sold to southeast and northeast Asia". When asked the trade scale of musk sale. He said: "The annual trade volume of musk is about 15~20 kg in that TCM market. During the period of 1983~1988, the annual trade volume was about 30 kg. However, before 1980s, the State controlled the musk trade with special concession, it was not like nowadays, there are hunters specialized in hunting musk deer". During the rest of day, we found no other musk dealer in that market. The stories told by different TCM dealers in different TCM market were similar.

August 18~29, 2001. TCM market in Yunnan

We visited the TCM markets and pharmacies in the Northwest Yunnan in late August and no musk sac for sale, only some TCM claimed contains musk derivatives. However, the owner of the gift shop offered the author musk sacs for sale. The situation in Fengjie County of Chongqing was similar, there was no musk sac for sale in

local pharmacies or markets except those TCM claim contain musk derivatives, but local people would sell a musk pod for 2,000 Yuan RMB.

August 30- September 2, 2001 Fengjie County, Chongqing City

A private TCM pharmacy

It was a small herbalist drug store in an old narrow damp street in the town of Kuizhou, Fengjie County by the Yangtze River. It was dark inside the shop. On the wall of shop, there hang bones or skeletons of bear, monkey and eagle, as well as dried snakes in a dark color that covered with dusts and cobwebs. That was the typical scene of private TCM clinic and drug store in small towns in China. I asked the storekeeper, a woman in her forties, if there was any musk for sell. She said: "Yes" and asked how much I needed. I asked how much she had. She said she had just got one gram musk for somebody else, if I needed, she could sell it to me first. "One gram is too little, I need one kilogram", I said. "Then, I will have to inquire someone in Chongqing, but it unlikely to find such amount of musk even there", the storekeeper said. Then she started to look for that one gram musk around, but surprisingly she found nothing. When I asked who was the person in Chongqing, she refused to answer. During the survey, that was a common situation when we probe the source of musk, the stall-keepers would never reveal it to us.

A TCM stall in Sanjiaoba

In the town of Sanjiaoba, an old TCM stall-keeper smiled and stared on us. We went into his store. Besides the front door, many TCM materials were placed on a wooden board. They were herbs, minerals and animal parts on display. Among them a musk sac and a tiger foot caught our eyes. We picked them up and checked them carefully. The musk sac was empty inside. The "tiger foot" was false one, after a carefully check, that was made with mainland serow's foot bone and skin with claws carved of water buffalo horn. During the musk market survey, such story happened in most of cases, the dealer sell wildlife counterfeits. For a similar "tiger foot" was also

found in the stall in Fengjie County town. So the frequency of occurrence of wildlife may not be a good indicator, except the part of wildlife is checked carefully.

September 26-28, 2001, Lanzhou, Gansu Province

Huanghe TCM material market

Huanghe TCM material market was the largest TCM raw material market in Northwest China. There were more than two hundreds TCM stalls in the market. During the days I was there, a TCM Raw Material Trade Show was on going. It was a good chance to probe the musk. Among the TCM raw materials the stalls showed, no musk or musk sac was found. Then I, as an honored guest of the trade show, visited several TCM raw material stalls. Of twenty stalls I visited, four of the stall owners expressed they had musk. The quantity of musk they could offer ranged from tens grams to near one kilogram, and the prices were all the same, 120 Yuan RMB/g. As the merchandise told me, some of the musk was kept in stores for tens of years, some were purchased in recent years. Through a summarization of questionnaires distributed in this market, a total of two kg musk in the stores of the Huanghe TCM market was estimated. As the strengthened law enforcement by the State in recent years, the illegal musk trade went to under the table in black market. In all TCM raw material markets we visited, little musk was presented in stalls; same as in the private run TCM pharmacies.

Appendixes

Appendix I Estimated numbers of musk deer in various areas in China during different periods

Species	1950-59	1960-69	1970-79	1980-89	1990-1999	Areas	References
All	2,000,000-3,000,000			<600,000		China	Sheng (1987)
All				200,000-300,000		China	Sheng (1998a)
All	>2,000,000					Southwest China	Wang (1994)
All		3,500,000	2,500,000	2,000,000	500,000-1,000,000 0	China	Zhang (2000)
All	700,000-800,000	500,000-600,000	500,000-600,000 000	300,000-400,000		Tibet	Zhang (2000)
All				125,000		Tibet	China MA of CITES (1999)
Siberian musk deer & forest musk deer Siberian					100,000-200,000	China	Sheng (1998a)
				15,400		Daxing'anling, Heilongjiang	Sheng (1998a)

musk deer

5,026	Heilongjiang	China MA of CITES (1999)
211	Helan	China MA of CITES (1999)
32,000	Northeast Forests, except above areas.	Sheng (1998a)
600-700	Dabieshan, Anhui.	Sheng (1998a)
<20,000	Northeast Forests, Jilin, Neimonggu and Liaoning.	Sheng (1998a)
11,390	Neimonggu.	China MA of CITES (1999)
5,026	Henan.	China MA of CITES (1999)
6-8	Mazongling, Anhui.	Sheng (1998a)
60	Panguangou, Shanxi.	Hao (1989)
>1,000,000	China	Sheng (1998, b)
75,000	Tibet	China MA of CITES (1999)

Forest

musk deer

Alpine musk deer		100	Qinghai	China MA of CITES (1999)
		41950	Gansu	China MA of CITES (1999)
		3980	Henan	China MA of CITES (1999)
		128-213	Guangxi	China MA of CITES (1999)
	<600,000		China	Sheng (1985)
		600-700	Anhui	Sheng (1998b)
		20,000-40,000	Fuling, Sichuan	Gao (1994)
		75,000	Tibet	Zhang (2000)
		180,000	China	Sheng (1998c)
		5,000	Qinghai	China MA of CITES (1993)
		126-386	Neimonggu	China MA of CITES (1993)

	500,000	100,000	Tibet	Yi (1993)
				China MA of
		13464	Gansu	CITES (1993)
			Huangnan Zangzuzhizhou	Zheng (1984)
	15,000	8,800		Sheng (1998c)
			Tibet	100,000
		125,000	Tibet	Zhang (2000)
Black		27,000	Tibet	Zhang (2000)
musk deer				China MA of
		27,000	Tibet	CITES (1993)
Himalayan		3,000	Tibet	Zhang (2000)
musk deer		3,000	Tibet	China MA of
				CITES (1999)

Appendix II Questionnaire for Musk Deer Breeding and Hunting Survey

Questionnaire for MUSK DEER BREEDING

1 Is there any musk deer breeding unit in your province, section, or town?

Yes: _____; No: _____.

2 If yes, number of musk deer the breeding unit: _____.

Number of the breeding musk deer: _____.

3 How many units have license for breeding wild animals?

4 Describe the procedure of applying for a license for breeding wild animals:

Records of the musk deer breeding:

Unit name	Manager	Address and zip code	Species of musk deer	Breeding amount

Questionnaire for MUSK DEER RESOURCE MANAGEMENT

1, Have you ever issued any hunting license to musk deer hunter since promulgating the Law of the Wild Animal Protection?

Yes: _____; No: _____.

2, If Yes, please fill out the table below:

Year	Applicant	No. of hunting license application	No. of licenses approved amount	No. of musk deer actually hunted

3, Whether TCM raw material companies need to apply for a license to purchase musk in your province (district, town) from the wild animal management?

4, Whether TCM medical companies need to apply for a license form the local wild animal management authority to produce TCM contains musk ingredient in your province (district, town)?

5, Do you need to apply license for transporting TCM contains musk ingredient?

Name of the institution (Seal)

Date

Appendix III Questionnaire for Records of Musk Purchase and Sell by the Corporations of Traditional & Herbal Medicine

Present storage _____ (g), of the stock _____ (g) was allocated by the higher
CORPORATIONS OF TRADITIONAL & HERBAL MEDICINE,

The amount purchased from TCM market _____ (g), Quality grade of the musk _____.

Average quality grade of musk in the market _____.

RECORDS OF MUSK PURCHASED (G) FROM THE MARKET DURING 1996—2001

The amount of musk purchased

Source: _____

Sell amount: _____

Year 1996

Sources: Allotted: _____; Market: _____.

Year 1997

Sources: Allotted: _____; Market: _____.

Year 1998

Sources: Allotted: _____; Market: _____.

Year 1999

Sources: Allotted: _____; Market: _____.

Year 2000

Sources: Allotted: _____; Market: _____.

Year 2001

Sources: Allotted: _____; Market: _____.

Musk sell records from 1996 to 2001:

Company: : _____.

Object: : _____.

1996: _____ g.

1997: _____ g.

1998: _____ g.

1999: _____ g.

2000: _____ g.

2001: _____ g.

Appendix IV Questionnaires for Peculiarities of TCM companies

Name of Company: _____

Address: _____ Postal code: _____

Tel.: _____ Fax: _____ E-mail: _____

Web site: _____

Liaison man: _____; Tel: _____ Fax: _____ E-mail: _____

Number of employees: _____

Total production value in 2000: _____

Production value from products contains natural musk: _____

If the State is going to manage the musk sale by special concession, Do your company wants to a the reason to be a designated musk dealer company with special concession? Yes: _____; No: _____.

If the Yes, Please explain the reason:

Suggestions:

Name of the company (seal)

Date

Appendix V Questionnaires for TCM Raw Material Market

Name of market _____ ; Number of the stall: _____ ;

Investigation date: Year _____ ; Month _____ ; Day _____

Do you know that the musk deer is the national key protected animal?

Yes _____ ; No _____ ; Uncertain _____ (Please tick "✓")

Please describe the license procedure of trading musk

How many years you have been dealing with musk?

Form _____ (year) to _____ (year).

Total musk you bought during 1996- 2001: _____ (kg) with the average price of (RMB ten thousand Yuan/kg).

The area of origin of the musk: _____

Total musk you sold from 1996 to 2001: _____ (kg) with the price of _____ RMB ten thousand Yuan/kg.

Of those sales: _____ kg were sold to companies; _____ kg were sold to private musk dealers.

The amount of musk you keep in stock at present time, _____ (kg) ; quality grade of the musk (Please tick "✓"): _____ Excellent; _____ Good; _____ Under average; Bad.

Your estimation of the quantity of musk in stock in the whole market _____ (kg); the overall quality of those musk is : _____ Excellent; _____ Average; _____ Not good.

Your impression of abundance of musk supply in the market using abundant, average and in short supply three ranks:

Year 1981—1985: _____ ; Year 1986—1990: _____ ;

Year 1991—1995: _____; Year 1996—2000: _____;

Year 2001: _____.

Will you sell the stock-in musk to state run company if retail price is good? (Please tick "✓") : Yes _____; No _____.

Acceptable retail price: _____ RMB ten thousand Yuan/kg.

If you have ceased sell musk, the reason is (Please tick main reason with "\", the secondary reasons with "\\") : _____ Short of source; _____ Unsatisfactory quality; Cannot sell it out; _____ due to the State policy); _____ Others.

Other explanations:

Appendix VI Questionnaire for Musk Use by TCM Manufacturing Company

Has any medicine that contains musk been manufactured in your company since 1995? (Please tick "✓")

Yes _____; No _____

Do you still use natural musk in your production?

Yes _____; No _____

If yes, please fill out: average annual consumption from 1996 to 2001 _____ (g)

In _____ kinds of medicines.

Of the musk used by your company, how much was allotted by the state run CORPORATIONS OF TRADITIONAL & HERBAL MEDICINE? _____ (g); How much was purchased from the market? _____ (g).

Your attitude towards labeling the TCM containing nature musk (Please tick "✓"):

Approval _____ Disapproval _____

If no, please fill out: since _____ that the use of natural musk has ceased, because of _____ shortage of supply, _____ bad quality of musk, _____ high price or _____ the others.
(serially numbering the blanks on the importance of the cause)

If is there abundant supply, would your company like to use natural musk again?

Yes _____; No _____

If yes, how much will be used: _____ (g).

Is your company using synthetic musk to produce TCM? (Please tick "✓")

Yes _____; No _____

If yes, since _____, it has been used, and the consumption in the year 2000 was _____ (g).

Labeling your products with "synthetic musk": (Please tick "✓")

Approval _____ Disapproval _____

Main causes for disapproval: _____ Unclear effect of synthetic musk, _____ or undetermined healing effect of the synthetic musk. (Rank the relative importance of the cause in the blank)