MUSK DEER FARMING
AS A CONSERVATION
TOOL IN CHINA

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AND
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Front cover photograph: Musk deer in Sichuan Institute of Musk Deer Breeding, China.

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MUSK DEER FARMING AS A **CONSERVATION TOOL IN CHINA**

by

Rob Parry-Jones and Joyce Y. Wu



An investor in Shanghai Chongmingdao Musk Deer Farm at the Musk Deer Captive Breeding Research Group of East China Normal University

CONTENTS

Acknowledgements	iii
Executive summary	iv
Introduction	· 1
Biological background and conservation status	1
Uses of musk	3
Threats to musk deer	4
Prices for musk in China	. 6
Supply and demand in China	7
Domestic and international trade - historical and present	, 8
International trade in musk	8
International trade and China	10
Alternatives	13
Protection measures for musk deer	14
International protection measures	14
Protection measures in China	. 16
Farming as a source of musk	17
Captive breeding outside China	17
Captive breeding within China	19
Summary and discussion	25
Recommendations	28
References	31
Annexes	1

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EXECUTIVE SUMMARY

Taxonomy of musk deer *Moschus* spp., in China and abroad remains uncertain, with at least four although possibly more than six distinct species. The China Red Data Book of Endangered Animals (Wang, 1998) lists five species occurring in China: *Moschus berezovskii, M. chrysogaster, M. fuscus, M. leucogaster* and *M. moschiferus*. The CITES Management Authority of China also reports the occurrence of five species in China, but notes the occurrence of *M. sifanicus* and not *M. berezovskii* (Anon, 1999). Musk deer are distributed from the Arctic circle in Russia to northern Mongolia and Korea, around the Gobi Desert to China, the Himalayan region, Afghanistan, Pakistan, Nepal, Bhutan, the Assam, Kashmir and Sikkim regions of India, and northern Cambodia and Vietnam.

Musk is used predominantly in traditional forms of medicine, but also in the perfume industry. Its use as an aromatic substance in China can be traced back to the Tang Dynasty in the eighth century, although records of its use as a medicinal substance go back much further to the Han Dynasty (200 B.C. - 200 A.D.). Musk remains an important medicinal ingredient in traditional Chinese medicine (TCM) as well as other forms of traditional medicine in East Asia. In TCM, musk is used for a variety of purposes, including: to revive unconscious patients and to stimulate circulation of vital energy and blood, in the treatment of delirium, stroke, trauma, and paralysis. It is also believed to possess anti-inflammatory and analgesic effects. There are around 400 patented medicines purporting to use musk in TCM and musk is also used in its raw form in the preparation of prescribed medicines. Demand in China is estimated to be in the region of 1000 kg per annum although estimates vary from 500 kg to 2000 kg per annum.

Musk has always been a sought after, and hence valuable, commodity. In the 1850s, musk was worth a quarter the value of gold, by weight. By the 1950s, it had quadrupled to the same value as gold and by 1978 it was worth three and half times the price of gold. Adulteration of musk is a common phenomenon and appears to be a generally accepted, albeit undesirable, practice. Prices in the 1990s ranged between USD2,604 /kg to over USD24,150 /kg, most likely reflecting the purity of the musk involved and the end market with the highest price paid by Japan for musk from China's musk deer captive breeding farms. In general, however, average wholesale price for musk appears to be in the region of USD11,000 /kg, and retail price in the region of USD21,000 /kg.

Although destruction of the musk deer's habitat is of concern, illegal hunting and trade fuelled by the high demand for use in traditional medicines and the high prices paid for musk pose the biggest threat to the long-term survival of musk deer. Population estimates vary considerably and it is not always clear how such estimates were reached. However, broad estimates for China indicate that the population has declined from over three million in the 1950s to between 200,000 and 300,000 in the 1990s. Populations declined by about 50% in the 1960s and the 1970s, and by about 50% in five years in the 1980s. Illegal hunting is still not under control and wild populations are believed to be decreasing rapidly. In one county in Sichuan Province, 200,000 snares were found in musk deer's natural habitat from 1990 – 1991. The indiscriminate methods employed to kill male musk deer mean that at least three to five animals may have to be killed in order to secure one male with a sufficiently large musk gland,

Recognition of the threats posed to China's musk deer populations and the importance of musk as a medicinal ingredient have resulted in various measures being enacted to protect musk deer in China. On paper, China has relatively comprehensive legislation and regulations regarding harvest, trade and use of musk. Musk deer are listed as Class II protected species under China's Wild Animal Protection Law (1988) and hunting of musk deer requires a permit issued by the provincial authority. In 1989, however, the hunting of musk deer to obtain musk was prohibited; export of natural musk from wild musk deer has been prohibited since 1997. Capture of animals to augment captive populations and export of musk from captive breeding operation is allowed, with the relevant permits. Despite these impressive measures, in reality, enforcement of wildlife trade regulations remains inadequate, and TCM companies in China are still obtaining musk for use in traditional Chinese medicine. Lack of communication and coordination between wildlife management, medicinal and enforcement authorities remains a pressing concern for the protection of musk deer resources in China.

At the international level, all species of musk deer not listed in Appendix II of CITES are listed in Appendix I. All species of musk deer occurring in China are listed in Appendix II of CITES. Exports of manufactured medicines containing musk are allowed by the CITES Management Authority of China with a CITES export permit. At the eleventh Conference of the Parties to CITES (COP 11), 10-20 April, 2000, recognition of declining populations of musk deer within their global range as well as high levels of illegal trade resulted in the Parties to CITES adopting Resolution Conf. 11.7 Conservation of and trade in musk deer. The main recommendations to the Parties in this Resolution are to improve enforcement efforts in order to reduce illegal harvest of and trade in musk; to develop identification guides and clear labelling systems for manufactured products containing musk; to develop alternatives to raw musk and to explore effective techniques for collecting musk from live musk deer in order to alleviate pressure on wild populations. Various decisions, directed at the Standing Committee, the Animals Committee and the CITES Secretariat, were also adopted at COP 11 to reinforce the intent of the Resolution.

International trade records for CITES-listed specimens, maintained by WCMC, show that, from 1991 – 1998, China imported 9 kg of raw musk but exported millions of medicinal derivatives purporting to contain musk. If these derivatives do contain musk, it is therefore most likely to have been obtained illegally and thus, CITES export permits should not have been issued, particularly as the impact upon musk deer populations must be significant. It is more likely, however, and supported by results of analysis in Taiwan of medicines from China purporting to contain musk, that the vast majority of these derivatives contain synthetic or counterfeit musk rather than genuine musk. Again, communication between the wildlife management and medicinal authorities is clearly required, as is the accurate labelling of medicines.

Synthetic musk was officially approved by China's Ministry of Public Health on 13 November 1993 and use of this synthetic musk has increased year after year. Synthetic musk has the potential to alleviate pressure on wild populations if supported by *in-situ* conservation, but is not the only alternative to genuine musk. Accurate assessments of wild populations and established and enforced harvest quotas could provide a sustainable means of providing musk.

However, this would require careful management with the pre-requisite that illegal hunting of musk deer is brought under control. Until reliable population estimates have been established and on-going illegal hunting and reported declines in musk deer arrested, it would be premature to pursue this option in China at the present time. As recommended in *Resolution Conf 11.7*, the capture and subsequent release of live wild musk deer to extract musk is another possible means put forward to obtain musk whilst providing an incentive to rural communities to protect musk deer and their habitat. High densities of musk deer and suitable habitat for catching the musk deer would be required for this method to work.

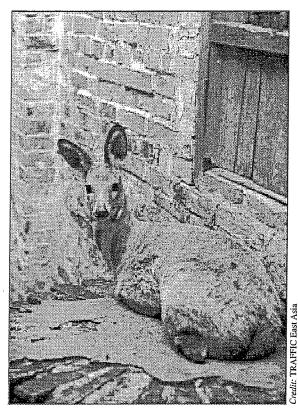
Civet musk is another alternative to musk from musk deer, and records of its use in China can be traced back to the Tang Dynasty. There are three species of civet which occur in China and from which civet musk can be used: the Lesser Indian Civet Viverricula indica, the Indian Civet Viverra zibetha, and the Malabar large-spotted Civet Viverra megaspila. Musk from the Muskrat Ondatra zibethica has also been put forward as an alternative to musk deer musk, although musk deer musk is still believed to be more effective than musk from civets and the muskrat.

Captive breeding of musk deer is believed by some to be a viable means of providing musk whilst at the same time protecting wild populations of musk deer. However, captive breeding of musk deer has been beset by difficulties, predominantly in the form of disease, low rates of reproduction and high mortality, since the inception of such programmes in the late 1950s. Recently there have been reported advances, mainly at the Sichuan Institute of Musk Deer Breeding, although China's total captive population of musk deer remains low. Total production of musk from China's musk farms is currently in the region of 6 kg per annum, and thus meets only between 0.3% and 1.2% of domestic demand. In theory, captive breeding of musk deer could provide a source for pure and legal musk and thus alleviate pressure on wild populations. However, in practice and based on current production figures, it is unlikely that China's musk deer farms will ever produce sufficient quantities of musk to meet domestic demand. Captive breeding of musk deer, however, could serve as a genetic 'safety' net for wild populations. Research of properly managed, self-sustaining captive populations may provide valuable information to benefit the species in the wild, providing that illegal hunting of wild populations of musk deer is brought under control. It is therefore particularly important that in-situ and exsitu conservation efforts support each other; successful ex-situ conservation efforts alone will not secure the long-term survival of wild populations of musk deer.

Communication between musk deer farms, musk deer researchers and exchange of information on captive breeding is crucial but severely lacking and there are currently no guidelines for the establishment and running of such farms. If musk deer captive breeding farms are to contribute to the conservation of musk deer in the wild then it is imperative that a system for exchanging information between farms is in place and standardized guidelines for operating these farms developed and implemented.

Communication between the relevant authorities responsible for wildlife conservation and regulation of wildlife trade and the medicinal authorities is also crucial but again lacking.

Despite China's evident commitment to the conservation of musk deer resources, collection and use of musk appears to be on-going by medicinal authorities. Dialogue is urgently needed and could be facilitated by the establishment of a cross-sectoral coordinating body on wildlife conservation and traditional health care. Further research is also required to determine current population estimates, to monitor trends of wild populations, to determine the amount of raw musk required per annum for use in traditional health care systems within China, and to determine the quantities of raw musk currently used in the production of patented Chinese medicines for consumption within China and abroad. Accurate labelling would medicines facilitate monitoring of the trade in musk and medicines purporting to contain musk.



Musk deer in Sichuan Institute of Musk Deer Breeding

INTRODUCTION

This study was undertaken to document trends in China's musk consumption, the sources of its musk supplies, and progress in its long-standing efforts to farm musk deer. The aim of undertaking this study was to ascertain the long-term sustainability of China's use of natural musk as medicine. Research methods included literature searches in Chinase and English, reviews of trade statistics, interviews with relevant experts in China, and visits to two musk deer farms in China in August 1998. A subsequent visit was made to the Sichuan Institute of Musk Deer Breeding in July 2000 with the Biodiversity Working Group of the China Council for International Cooperation on Environment and Development.

BIOLOGICAL BACKGROUND AND CONSERVATION STATUS

Although musk deer have previously been classified in the family Cervidae (Flower, 1875; Heptner and Naumov, 1961), many scientists today group them within their own separate family, Moschidae (Brooke, 1878; Flerov, 1952; Groves and Grubb, 1987 and Whitehead, 1972). Debate continues over the taxonomy of musk deer although there is now broad agreement for four species and their distribution (Wemmer, 1998), as illustrated in Table 1.

Table I
Distribution and CITES-listing of Moschus spp.

Scientific name	English common name	CITES listing	Distribution
M. berezovskii	Forest Musk Deer	П	China and Vietnam
M. chrysogaster	Himalayan Musk Deer	1/11	Afghanistan, China, India, Nepal and Pakistan
M. fuscus	Black Musk Deer	1/11	Bhutan, China, India, Myanmar and Nepal
M. moschiferus	Siberian Musk Deer	1/П	Russia, Kazakhstan, Kyrgyzstan, China, Korea and Mongolia

Source for taxonomy and distribution: Wemmer, 1998

Source for CITES listing: Anon., 1998

Musk deer are distributed in the East Asian mountain areas: from the Arctic circle in Russia to northern Mongolia and Korea, around the Gobi Desert to China, the Himalayan region, Afghanistan, Pakistan, Nepal, Bhutan, the Assam, Kashmir and Sikkim regions of India, and Vietnam (Green, 1986). All musk deer are listed in Appendix I or Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Protection afforded to musk deer by CITES is discussed later in **Protection measures for musk deer**.

The China Red Data Book of Endangered Animals (Wang, 1998) lists five species occurring in China: *Moschus berezovskii*, *M. chrysogaster*, *M. fuscus*, *M. leucogaster and M. moschiferus*. Reflecting the general taxonomic uncertainty for musk deer, the CITES Management Authority of China recognises *M. sifanicus* but not *M.berezovskii* as distinct species, and reports the occurrence of five species in China: *M. chrysogaster*, *M. fuscus*, *M. leucogaster*, *M. moschiferus* and *M. sifanicus* (Anon., 1999), Table 2.

Table 2
Distribution of Moschus spp., in China (using current Chinese nomenclature of the CNMA)

Scientific name	Distribution in China
M. moschiferus	Heilongjiang, Jilin, Liaoning, Beijing, Inner Mongolia, Shanxi, Xinjiang
M. chrysogaster	Henan, Shaanxi, Sichuan, Guizhou, Yunnan, Hunan, Gansu, Qinghai, Xizang (Tibet), Anhui, Hubei, Guangxi and Guangdong
M. sifanicus	Ningxia, Shaanxi, Qinghai, Sichuan, Yunnan and Xizang (Tibet)
M. fuscus	Gongshan and Liuku in Yunnan Province Chayu, Motuo, Milin, Linzhi and Bomi of Tibet Autonomous Region
M. leucogaster	Yadong, Zhangmu and Jilong of Tibet Autonomous Region

Source: Anon., 1999

Musk deer are herbivores with a diverse diet. They eat high-protein, high-calorific and low-fibre plants, with their diet changing according to the season. In the winter, mainly moss and lichen, leaves of deciduous and evergreen trees, are eaten (Xu, H., in litt., to TRAFFIC East Asia, June 2000) although their secondary source of food consists of broad-leaved grasses and bracken. In spring, tree buds and shoots are consumed as well as moss and lichen, broad-leaved grasses and bracken; in summer, broad-leaved grasses and bracken are main sources of food while shrubbery, leaves of trees, bamboo, moss and lichen make up secondary sources of food (Green 1987a, Liang et al. 1992).

Male musk deer, on average, mature at 1.5 to 3 years and female musk deer are thought likely to conceive as early as one year old. The mating season of the musk deer is from November to January (Yan 1985), although starts in the middle of October until January at the Shanghai Chongming Musk Deer farm (Xu, H., *in litt.*, to TRAFFIC East Asia, June 2000). After 150 to 195 days of gestation, the female musk deer gives birth to 1-2 fawns in May or June with an average weight of 450g for 2 fawns and 500g for 1 fawn (Xu, H., *in litt.*, to TRAFFIC East Asia, June 2000).

The word 'musk' derives from the ancient Indian word 'muskah' meaning testicles. Most likely this alluded to the musk pod – the preputial gland - of the male musk deer, located between the navel and the genitals (Homes, 1999). 'Musk' refers to the secretion from the scent gland the scent of which comes mainly from "muscone" – a compound first isolated in 1906. Musk is

thought to be used to mark territory and to attract females for mating. The male musk deer begins to secrete musk in his second year and continues to do so up to the age of 20, though the peak period for secretion is from ages three to nine years (Yan, 1985; Green, 1989).

The size and weight of musk pods differ according to the species of musk deer (Yang, Q., in litt., June 2000), the age of the deer and the season in which the pods are collected. Normally, they are 3-7cm in diameter, 2-4cm deep (Feng et al. 1981; Anon. 1995a). The amount of water contained in natural musk varies according to the time of year, local environment, food, the way the musk is handled after it is collected, and how long it has been stored. Musk collected in summer, "summer musk", is moist and contains 52-57% water; musk collected in winter, "winter musk", is dryer and contains 28-30% water (Zeng 1984). A male musk deer of poorer physical condition secretes musk that is only 41-46% of the musk secreted by a healthy male musk deer (Yan, 1985) although sometimes will secrete no musk (Xu, H., in litt., to TRAFFIC East Asia, June 2000).

The weight of a musk pod and the amount of musk that can be obtained from one pod vary. Bannikov et al. (1980, in Green 1983) note that a musk pod may weigh between 10 - 15g although as much as 50g. Green (1983) believed that musk pods in the early 1980s averaged just under 1 oz (25g) but noted that estimates for pod weight may have to be revised repeatedly, due to hunting pressure which increasingly leads to a greater proportion of young animals bearing smaller pods being killed. The percentage of musk grain to weight of a musk pod reportedly varied from 44% (Pereira, 1857) to around 50% (Wallis, 1951). In the 1990s, medicinal companies calculate the weight of musk grain obtained from musk pods using the following formula: weight of musk pod x 80 % (for shell of pod) x 80 % (for water in musk). Therefore, 100g of musk pods would yield 64g of dry musk grain (Xu, H., in litt., to TRAFFIC East Asia, 21 June 2000).

USES OF MUSK

Musk is used predominantly for medicine but also in the perfume industry. In China, the use of musk as an aromatic substance can be traced back to the Tang dynasty in the eighth century (Green 1983). In Europe, musk is still used in the perfume industry for top-of-the-range perfumes. The cosmetic industry uses more than 900 types of artificially synthesized musk, but only 30 are economically important (Homes, 1999). The quantity of natural musk from musk deer used in perfumes is very low in comparison to the demand for and use of musk in Asian medicines. In future, it is expected that the use of natural musk in perfumes will decline further, due to the already high and increasing price of musk (Homes, *in litt.*, to TRAFFIC East Asia, 21 July 2000). The main use for musk, however, is in traditional medicines.

Musk is used as a medicinal substance in Islamic countries, India and countries of the Far East (Anon., 1994, Green 1983). It use in medicine was recorded by Aetius, the Greek physician, in circa 520 AD (Pereira, 1857, in Green 1983), and in China and India musk has been considered a superior medicine since the fifth century AD (Green, 1983; Anon., 1994). However, as early as the Han Dynasty (200 B.C. - 200 A.D.), records in Shennong Bencao Jing (Shen Nong's

Herbal Classic) show the use of musk in traditional Chinese medicine (TCM) to treat a variety of ailments. According to the Pharmacopoeia of the People's Republic of China, musk can revive unconscious patients, stimulate circulation of vital energy and blood, and it also possesses anti-inflammatory and analgesic effects. It is used in the treatment of delirium, stroke, unconsciousness, miscarriage, ejection of stillborn fetus, acute angina pectoris, acute abdominal pain, skin infection, sore throat, sprained joints, trauma, and paralysis (But, in press).

There are 398 patented Chinese medicines using musk as an ingredient (Hu, S., Institute of Chinese Materia Medica, Beijing Academy of TCM, in litt., to TRAFFIC East Asia, September 1998). The use of musk is thought to be greatest in four medicines: She Xiang Bao Xin Wan made in Shanghai, Yunnan Bai Yao made in Yunnan, Pian Zai Huang made in Fujian, and Liu Shen Wan made in Tianjin (Xu, H., in litt., to TRAFFIC East Asia, June 2000). An official letter (No.133) issued by the Ministry of Forestry (now the State Forestry Administration) in 1990, provides a list of 165 medicines containing musk, for which export permits must be issued. Further details are provided below in **Protection measures in China**.

THREATS TO MUSK DEER

The demand for musk for use in medicine poses the biggest threat to musk deer, fuelling illegal hunting for the musk pod. Habitat destruction is also an important factor threatening the long-term survival of musk deer (Wang, 1998). According to an "Emergency Notice" promulgated by the Qinghai Provincial government in 1987, 66,000 musk deer were illegally hunted in Qinghai between 1985-1986 (Harris 1991 in Anon., 1993). In 1989, the population of musk deer in China was reported to be about 300,000 and declining rapidly (Sheng, 1989, in Anon., 1993). In Baiyu county, Sichuan Province, 200,000 snares were found in musk deer's natural habitat from 1990 – 1991. The indiscriminate methods employed to kill male musk deer, such as snares, mean that at least three to five animals may have to be killed in order to secure one male with a sufficiently large musk gland (Green, 1986 in Homes, 1999).

Despite China having an estimated carrying capacity of at least 4,000,000 individuals, based on calculations of two individuals per km² in available suitable habitat (Sheng, 1987, in Anon., 1999), the population has declined from over three million in the 1950s to between 200,000 and 300,000 in the 1990s, **Table 3**. Populations of musk deer declined by about 50% every ten years in the 1960s and the 1970s; in the 1980s, the population decreased by about 50% in five years (Sheng, 1996).

The population status of musk deer in selected areas of China is presented below in **Table 4**, based on information provided by the CITES Management Authority of China (CNMA) in Anon. (1999). The population status was based on the results of surveys carried out from 1992 – 1993 and references from recent years (Anon., 1999).

Musk deer are also reported in the provinces of Sichuan, Xinjiang, Ningxia, Shaanxi, Jilin, Liaoning, Anhui, Guizhou, Yunnan, Hubei, Shanxi, Hunan, Guangdong, Guangxi Autonomous Region and, reportedly in Beijing municipality (Anon., 1999).

Yang (in litt., to TRAFFIC East Asia, 6 June 2000), however, notes that these areas of distribution for musk deer in China are more likely to reflect the historical rather than current distribution. Wang (1998), too, notes that the musk deer is most likely extirpated from Guizhou Province, and Sheng (1996) notes that in Helan Mountain, situated in Inner Mongolia and Ningxia Autonomous region, a 1985 survey counted 1600 deer in the 1800 km≈ forestry reserve although a survey conducted in the same site in July 1995, counted less than 100 musk deer. Yang (in litt., to TRAFFIC East Asia, 6 June 2000) and Harris (in litt., to TRAFFIC East Asia, 5 June 2000) also note that it is not clear how the population figures provided in Tables 3 and 4 were reached, and thus may not reflect the actual situation. Population figures, as presented in Tables 3 and 4, should therefore be regarded as providing an indication only of the status of musk deer in China.

Table 3
Estimated population status of musk deer in China, 1950s to 1990s

Period	Population	Source of population information		Annual harvest (kg)
1950s	Around 3,000,000	Yuan et al., (1992); Anon.	(1999)	1400 - 1700
1960s	2,500,000 - 3,000,000	Anon., 1993	4	2000 - 3000
1970s	1,000,000 - 2,000,000	Yuan, C., et al. (1992)		1500
1980s	Around 600,000	Sheng, 1996		500
1990s	200,000 - 300,000	Wang, S. (1998)		Hunting prohibited in 1989

Source of annual harvest information, 1950s to 1970s: Anon., 1999 Source of annual harvest information, 1980s: Sheng, 1996

Table 4
Population status of Moschus spp. in selected areas

Species / Region	Tibet	Qinghai	Inner Mongolia	Gansu	Heilongjiang	Henan	Guangxi	Total
M. moschiferus			11390		5026	211		16627
M. chrysogaster	75000	100		41950		3980	128-213	121030
M. sifanicus		5000		13464				18464
M. fuscus	27000							27000
M. leucogaster	3000							3000
Total	105000	5100	11390	55414	5026	4191		186121

Source: Anon., 1999

Sheng (1996) does, however, report high densities of musk deer (30 per km²) in Mt Xinglong Nature Reserve, Gansu Province, due to strict control and management, recruitment of former hunters to work within the reserve, and close cooperation between forestry police and rangers, etc. As the reproduction rate for female musk deer is between 1.5 and 1.7 young per year, it should be possible within five to ten years to restore population levels in other reserves to around 8 – 10 musk deer per km² (Sheng, 1996).

The CITES Management Authority of China notes that further information on the distribution, status, biological habits, trade and administration status of musk deer in China will be available in the near future, based upon a survey conducted between 1995 – 2000 (Anon., 1999). At the time of writing, however, the survey had not been concluded.

PRICES FOR MUSK IN CHINA

The high price paid for musk on China's domestic market and on international markets provides a clear incentive for illegal hunting of musk deer and, with the relative ease of concealment and low levels of enforcement, illegal trade in musk poses a severe threat to musk deer.

In the late 1980s, in an effort to encourage breeding of musk deer, the Chinese Government set the purchase price of musk from captive-bred musk deer at RMB 20,000 /kg and the price of musk from wild musk deer at RMB 10,000 /kg. Based on the average year-end exchange rates (1986 – 1989) from the US Federal Reserve Statistical Release (Anon., 2000), musk from captive-bred deer was worth USD 5,025 /kg and from wild musk deer worth USD 2,513 /kg. However, musk pods were reportedly worth in the region of RMB 2 000 (USD 502) on China's black market and musk pods, on average, weighed around 10 – 15g (Fan, Z., pers. comm., to TRAFFIC East Asia, September 1998). Extrapolating from these figures, China's black market price for musk in the late 1980s may thus be calculated to be in the region of USD 41,859 /kg although, due to exchange control measures in place in China at that time, straight conversions from RMB to USD could distort price comparisons.

In the mid-late 1990s, prices for musk in China's domestic market reportedly ranged from RMB 80,000 to RMB 100,000 per kg (USD 9,662 to USD 12,077 /kg) (Zhou, *et al.*, 2000), although a survey of TCM stores, conducted in 1996, reported prices for musk ranging from RMB 92.4 per gram (RMB 92,400 /kg; USD11,100 /kg) to RMB 30 per 0.2 g (RMB 150,000 /kg; USD18,100 /kg) (Guo, *et al.*, 1997).

In Shanghai, a State-run medicine company reportedly still buys musk from wild musk deer at RMB 86,000 /kg (USD10,386 /kg). The musk is then sold in pharmacies for RMB 36.00 for a small tube (1.67g) – or the equivalent of RMB 21,557 /kg (USD 2,604 /kg). While this lower retail price per kilogramme would appear to incur a loss, the musk sold is reportedly low quality musk and likely to have been adulterated with other substances (Xu, H., *in litt.*, to TRAFFIC East Asia, 20 July 2000).

In 1998, three kilogrammes of musk were exported from China to a perfume company in Japan with a quoted value of RMB 500,000-600,000 /kg (around USD20,130 to USD24,150 /kg), but the actual value was probably higher (Fan, Z., pers. comm., to TRAFFIC East Asia, September 1998).

During interviews with a TCM trader in Hong Kong in 1999 and 2000, the wholesale price of musk was stated to be around USD10,000 to USD12,000 /kg. The musk originated in the Russian Federation (Anon., pers. comm., to TRAFFIC East Asia, 31 May 1999 and 26 June

2000). The retail price for musk in 2000 was HKD 160 /g, equivalent to USD20.65 /g or USD20,645 /kg, although the trader also noted that the price was dependent upon the quality of the musk which varied from country to country (Anon., pers. comm., to TRAFFIC East Asia, 26 June 2000).

Recent data, as noted above, show prices for musk ranging from RMB21,557 /kg to over RMB600,000 /kg (USD2,604 to over USD24,150 /kg). Most likely this range reflects what appears to be a generally accepted fact of the trade - that raw musk is adulterated with other substances. The musk exported to Japan from China would have originated from China's captive breeding farms, and thus the high price, most likely, reflects the purity of the musk and the end market. In general, however, the average wholesale price for musk appears to be in the region of USD11,000 /kg, and retail price in the region of USD21,000 /kg.

SUPPLY AND DEMAND IN CHINA

There do not appear to have been any systematic studies to determine the amount of musk required in China for medicinal use. Various estimates have been put forward, however: Wang and Yu (1996) estimated demand to be in the region of 500 – 1000 kg per annum for medicinal use; Zhou et al. (2000) estimate demand in China to be around 1000 kg; and one source from the Beijing Academy of Traditional Chinese Medicine estimates demand to have averaged around 2000 kg per annum for the last 50 years (Hu, S., in litt., to TRAFFIC East Asia, Sept 1998).

Musk in trade, however, is usually adulterated (Green, M.J.B., *in litt.*, to TRAFFIC East Asia, 17 July 2000) and, thus, lower levels of demand may reflect the amount of pure musk required. What remains unclear from these estimates, however, is whether 'medicinal use' refers to traditional Chinese medicine (TCM) only, or whether other forms of traditional medicine, such as traditional Tibetan medicine (TTM) for which musk is an important ingredient, are also included. If demand for musk for use in TTM is excluded from this estimate, the general estimate of 1000 kg *per annum* should be regarded as the minimum.

Whilst demand remains high, supply is declining. Results of a questionnaire survey conducted by the Chinese Academy of Science and sent to 13 TCM manufacturers revealed that, for the period 1990 – 1995, average combined consumption of natural musk by seven manufacturers was around 255 kg *per annum*. There are around 1000 TCM manufacturers in China of which 104 are key manufacturers (Guo *et al.*, 1997).

The survey also reported that in Sichuan Province purchase of musk plummeted from over 200 kg from 1990 – 1993 to less than 2 kg in 1994 to 1995 – all of which was sourced from the wild. Five TCM companies, which responded to another questionnaire, reported purchasing a total of 1719.2 kg of musk and selling a total of 1881.5 kg from 1990 – 1995. Purchase had declined from an average of over 400 kg per year from 1990 – 1993 to an average of around 15 kg per year in 1994 - 1995 (Guo *et al.*, 1997), as illustrated in **Figure 1**.

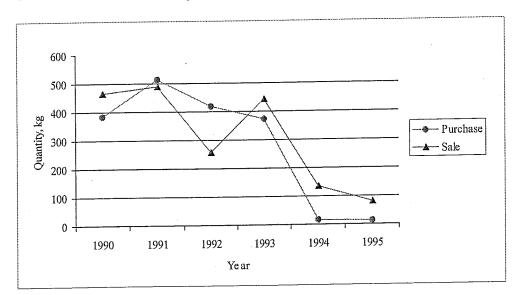


Figure I
Purchase and sale of musk by five TCM companies, 1990-95

Despite continuing high demand for musk, purchase and sale of musk in China for TCM declined noticeably during the mid-1990s. The provincial forestry departments, under the State Forestry Administration (formerly the Ministry of Forestry), are responsible for managing and protecting musk deer in the wild. In an effort to conserve wild musk deer populations, China prohibited the hunting of wild musk deer for musk in 1989 – although the trapping of musk deer to augment captive populations is still allowed (Fan, Z., pers. comm., to TRAFFIC East Asia 3 February 2000). Despite these measures to conserve musk deer populations, purchase of musk still continues by the medicinal authorities regardless of the status of the musk deer resources in the wild and regardless of the measures in place to protect musk deer (Sheng, H., 1996).

DOMESTIC AND INTERNATIONAL TRADE - HISTORICAL AND PRESENT

International trade in musk

The first recorded mention of musk in Europe, which used to play a key role in the international trade, was by St Jerome in circa 340 AD (Bovill, 1953 in Green, 1983). Musk on the European market was dominated by exports from China in the late 1800s and early 1900s (Green, 1983). By the 1930s and 1940s, musk exported from China constituted 70% of all international musk in trade (Yuan *et al.* 1992). In the 1850s, musk was worth a quarter the value of gold, by weight. By the 1950s, it had quadrupled to the same value as gold but by 1978, musk was worth 3.5 times the price of gold (Green, 1983).

From 1979 to the early 1980s, the majority of Japanese imports of musk originated from China and were smuggled through Hong Kong (Green, 1983). From 1979 to 1985, over 1154 kg of musk was smuggled from China to Japan (Anon., 1999). Smuggling of musk into and through

Hong Kong was conducted on such a large scale that the price of musk in Hong Kong fell 25% from 1979 to 1981. Musk smuggled into Hong Kong and exported to Japan also caused the price of musk to fall on the international market (Green, 1983).

From 1973 to 1982, Green (1983) reports that Japan's musk consumption for the medicine and perfume industries constituted about 80% of total international trade in musk; imports of musk into Japan averaged an estimated 265 kg *per annum* with a reported annual value of USD4.4 million (USD16,700/kg). A large-scale commercial enterprise in Japan imported 90 kg of musk at USD37,000/kg in 1980, and the same enterprise imported 200 kg of musk in the first ten months of 1981 with a value of USD14,000/kg (Green, 1983).

CITES Annual Reports show that, from 1991 to 1998, the majority of reported international trade in *Moschus* spp. was in musk or its derivatives. Trade in other *Moschus* specimens was derived from live animals, trophies, bones, skin and scientific specimens.

Whilst these international trade records, maintained by the World Conservation Monitoring Centre (WCMC), provide an indication of the main trading nations, destination and origin of musk in trade, it is often not possible to ascertain the quantity of musk in trade. It is not clear whether records of musk in trade refer to musk grain or to musk pods – both of which appear in international trade – and there are no standardised units for recording international trade in musk derivatives.

Interpretation of trade data is further complicated as musk is often adulterated with other ingredients (IUCN and TRAFFIC, 2000; Green, 1986; Tsui and Choi, in press). Adulteration of musk is not a recent phenomenon: a wide variety of adulterated musk products were already in existence by the fifteenth century. In seventeenth century India, the traveller Tavernier reportedly bought 7673 musk sacs weighing a total of 2557.5 oz., but obtained only 452 oz. of musk (Cooke, 1925 in Green, 1983). These caveats need to be borne in mind when analysing international trade statistics as reported in the CITES Annual Reports.

Between 1991 and 1998, nine economies (including Hong Kong) reported total imports of 2718 kg of musk, substantially greater than reported exports of musk which totalled 656 kg. According to the CITES Annual Reports, the main countries/territories importing raw musk were, respectively, the Republic of Korea, Hong Kong, Japan and Germany. Reported imports into Korea (2302 kg) represented 85% of total imports. The only range States which reported exports for the period of record were the former Soviet Union, the Russian Federation, Georgia, China and Mongolia. Trends in the international trade in raw musk between 1978 and 1996 indicate a dramatic increase in export figures from Russia (including Kyrgyzstan and Uzbekistan) after the break-up of the Soviet Union in 1992 (Homes, 1999). Illegal trade still remains a serious problem. For example, of the 240 kg of musk that was reported as officially traded in the Russian part of the Soviet Union and in Russia from 1989 to 1993, 30 – 40%, or approximately 70 – 100 kg, was estimated to be from illegal sources (Prikhod'ko, 1997, in Homes, 1999). From 1994 to 1996, around 1 200 kg of musk were imported into South Korea under questionable circumstances from Kyrgyzstan, Uzbekistan, Mongolia and Cambodia, while 230 kg were imported illegally from Korea P.D.R. (IUCN and TRAFFIC, 2000).

International trade and China

In the early 1900s, China exported an estimated 617 - 1850 kg of musk per year and consumed at least as much musk domestically (Green 1983). In the early 1980s it is estimated that total annual musk production in China was 2000-2500 kg, of which 500 kg originated from *M. berezovskii* (Wang *et al.*, 1993, in Wemmer, 1998).

From 1990 – 1998, CITES Annual Reports reveal that China did not record any imports of raw musk. Russia, however, reported the export to China of one kilogramme of raw musk in 1993 and eight kilogrammes of raw musk in 1997. Export of natural musk obtained from the wild has been prohibited since 1997 (Fan, Z., pers. comm., to TRAFFIC East Asia 3 February 2000); exports of natural musk recorded after this time are therefore from China's musk deer captive breeding farms (Table 5). China does, however, report the export of large quantities of musk derivatives - predominantly in the form of Chinese medicines (Table 6). Export of medicines containing musk is allowed with the correct permits in accordance with Official Letter No. 133 (1990), and (1999), as discussed below in **Protection measures in China**.

Table 5
Gross exports of Moschus specimens from China, 1991 – 1998

-	Body	Bone pieces	Bones unit unknown	Skin pieces	Musk unit unknown	Musk kg	Oil bottles	Horn* products	Moschus spp. unit unknown
1991	0	0	0	0	0	0	. 0	0	0
1992	0	Õ	ň	0	0	0	0	0	0
	0	0	n	5	Ô	0	1	0	0
1993	0.	0	0	215	ő	0	0	0	0 .
1994	,	0	5	4	1000	1.5	0	0	0
1995	1	Ž	16	7	13	3	0	0	0
1996	0	0	10	0			0	4	2
1997	0	0	0	0	0	3	U	7	~
1998	0 -	0	0	0	6	2	0	1	U ,

^{*} References to horn presumably refer to the canines of the male musk deer.

Source: World Conservation Monitoring Centre

Table 6
Gross exports of musk derivatives from China, 1991 - 1998

	Bags	Bottles	Boxes	Cartons	Cases	g	kg	Unit unknown	Total derivatives
1991	20000	10	282434	125241	0	0	0	457713	885398
1991	144000	0	262690	8433	107	0	0 .	339228	754458
1992	0	0	6	452	0	0	0	13898	14356
1993	33	0	3500	20109	0	150	0	574186	597978
1995	276	0	4020	635	0	0	15	890634	895580
1995	0	0	25600	740	0	0	7	1506807	1533154
	0	0	28530	481	Ô	0	42	321650	350703
1997 1998	0	0	12000	516	Ö	11	805	115808	129140
Total	164309	10	618780	156607	107	161	869	4219924	5160767

Source: World Conservation Monitoring Centre

Although exports from China are very high, trade is reported by boxes, cartons, etc., and thus interpretation of the data is difficult. For example, in 1996 China exported a total of 1,533,154 derivatives, including 25,600 boxes, 740 cartons and seven kilogrammes of derivatives. From 1991 to 1998, China exported a total of 5,160,767 musk derivatives. China's CITES Management Authority (CNMA) notes that the Tianjin LeRenTang Medicine Factory produces 400 boxes of Shaoyaowan medicine every year although less than 30 g of natural musk and some synthetic musk are used (Anon., 1999). The vast majority of patent medicines purporting to contain musk most likely contain synthetic musk only, with genuine musk being used in raw form when prescribed in hospitals (C.S. Cheung, HKSAR AFCD, *in litt.*, to TRAFFIC East Asia, 27 June 2000).

Results of forensic analysis, conducted by the Investigation Bureau of the Ministry of Justice, Taiwan, of medicines purporting to contain musk support the hypothesis that many of the patent medicines from China and claiming to contain musk do not, in fact, contain natural musk. Analysis of musk pods from China also revealed the high percentage of counterfeit musk pods on the market.

Seventeen musk pods and 77 plasters purporting to contain musk and tiger bone were obtained from seizures by Kaohsiung Customs Bureau in 1994 – 1995 (Kaohsiung / Gaoxiong is a port located in the southwest of Taiwan) (Lin 1997; Lin et al., 1999). Products claiming to be musk derivatives originated from medicinal or health product factories in China (Lin, 1997). An additional 32 musk pods, obtained from TCM stores in Taiwan were also analysed (Lin et al., 1999).

Muscone (3-methylcyclopentadecanone-1) is an odiferous secretion from the musk pods of *Moschus moschiferus*, *M. berezovskii*, and *M. sifanicus*. Muscone from these sources is enantiomerically pure (*l*-form). Synthesized muscone is normally in racemic mixture (*d*-form). It is not yet possible to differentiate between *l*-form muscone and *d*-form muscone. However, small amounts of muscopyridine are also found in musk pod secretions and thus, the presence of this chemical in muscone samples most likely indicates that the muscone is from the male musk deer. Common counterfeits contain the following ingredients: Musk xylene; Musk ambrette; Musk ketone (Lin *et al.*, 1999).

Results of the analysis showed that of the 17 musk pods seized by Kaohsiung Customs, 100% were counterfeit. Of the 77 musk-tiger bone plasters seized, only one was found to contain muscone (*l*- or *d*-form). No muscopyridine was detected and thus it is more likely, but not definite, that this sample contained synthetic muscone (*d*-form). Of the 32 musk pods provided by TCM stores in Taiwan, 26 were found to contain muscone in *l*- or *d*-form. Of these 26 samples, five were found to contain muscopyridine, indicating that these five musk pods most likely were genuine. The other 21 musk pods contained muscone in *l*- or *d*-form and thus it is likely, but not definite, that these were not genuine musk pods. Three musk pods were found to contain counterfeit muscone (Musk xylene, Musk ambrette, or Musk ketone) although one of these samples also included muscopyridine, indicating that this sample most likely contained natural musk (muscone *l*-form) from musk deer as well as counterfeit muscone. Findings are illustrated in **Table 7**.

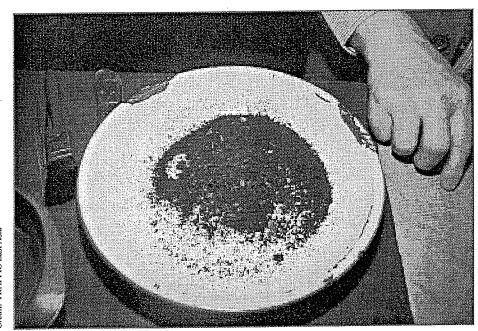
Table 7
Forensic analysis of musk pods and medicines purporting to contain musk

Product name	Total no. of cases	Muscone l- and d-form	Muscone counterfeit ingredients	Counterfeit ingredients	None
Musk gland (from TCM stores)	32	26 (81%) a	3 (9.4%) b	3 (9.4%)	0 (0%)
Musk gland (from Customs)	17	0 0%	0 0%	0 0%	17 100%
Musk-tiger bone plaster (from Customs)	77 ·	1 (1.3%) c	5 (5.4%) d	15 (19%)	56 (74%)

a, b, c, d: Numbers of samples found to contain muscopyridine are 5, 1, 0, and 0, respectively

Source: Lin et al., 1999

It would appear that the majority of manufactured traditional Chinese medicines purporting to contain musk do not actually contain genuine musk. Export of medicines containing synthetic musk does not require a CITES permit and trade is thus not required to be reported in CITES Annual Reports. If very small amounts of natural musk were used in combination with synthetic musk in the preparation of these medicinal derivatives, a CITES permit would be required for export. However, the export of over five million derivatives would still require a substantial quantity of musk, the origins of which are unknown but of questionable legality.



Natural grains of musk from musk pods

Credit: TRAFFIC East Asia

Accurate labelling of medicines and standardised units of measurement for recording trade in musk derivatives would facilitate considerably in determining the legal status of musk used in medicinal preparations and in making an assessment of international trade in musk.

ALTERNATIVES

Various means have been explored to alleviate the pressure placed on wild musk deer populations from demand for musk.

If properly managed, and if illegal hunting of musk deer can be brought under control, the sustainable hunting of male musk deer to obtain musk should not be overlooked as one means of meeting, or contributing towards meeting, demand for musk. This would require accurate assessments of population status with an established quota for sustainable off-take. This option might be feasible in certain areas of the Russian Federation (TRAFFIC Europe, *in litt.*, to TRAFFIC East Asia, 12 July 2000). Sheng (1996) also notes that in protected areas in China, sustainable off-take of musk deer may be possible at a rate of 8 - 10 deer per km² and at a rate of 3 - 5 deer per km² in non-protected areas. Until reliable population estimates have been established in China, however, and on-going illegal hunting and reported declines in musk deer arrested, it would be premature to pursue this option in China at the present time.

Harvest of natural musk from live wild deer and subsequent release of the deer has also been put forward as one option which would provide an incentive to rural communities both to protect musk deer and to protect their habitat. Effective and suitable means of capture, however, remain constraints (Green 1987c; Green and Kattel, in press). Some success, however, has been recorded: Kattel (1992 in Green and Kattel, in press) developed a technique whereby previously located animals were driven by a team of 10 - 12 persons into nets where the animals were immobilised for the purposes of attaching radio-collars and extracting musk. A 56% success rate was observed rate (25 captures out of 45 attempts) (Kattel, 1992, in Green and Kattel, in press). The high rate of capture for this method, however, was likely related to the high protection afforded to musk deer in the study area and therefore not easily replicated in other areas (Harris, *in litt.*, to TRAFFIC East Asia, 5 June 2000).

Artificially synthesized musk has also been explored as a substitute to natural musk for use in TCM and experiments have reportedly shown there to be no significant difference between the curative effects of synthetic musk and that of natural musk (Zhu *et al.*, 1994). The Ministry of Public Health of China officially approved artificially synthesized musk as a class one medicine (approval code (93) Z-70) on 13 November 1993 (But, in press) and use of synthetic musk has increased year after year since 1993 (Anon., 1999).

Alternatives to musk from musk deer have also been sought to alleviate the demand on wild populations. References to the use of alternatives, in the form of civet musk, can be traced back to the *Ben Cao Shi Yi* (A Supplement to the Herbals) written in the eighth century in the Tang Dynasty by Chen Changqi. The Ming Dynasty's *Ben Cao Gang Mu* (Compendium of Materia Medica) written by Li Shizhen in 1570 AD also contains reference to the use of civet musk (Liu, 1991a).

Civets, of the family Viverridae, include 70 species of 34 genera of which China has 11 species of 9 genera (Liu, 1991a). Every species of Civet has a gland that secretes civet musk, but only the civet musk of 5 species of 3 genera can be used to make perfume and medicine (Liu, 1991a). China has 3 species of 2 genera that produce civet musk used in medicine and perfume, the Lesser Indian Civet Viverricula indica, the Indian Civet Viverra zibetha, and the Malabar largespotted Civet Viverra megaspila (Liu, 1991a). The population of the Malabar large-spotted Civet is believed to be very small in China (Xu, H., in litt., to TRAFFIC East Asia, 21 June 00). Civet musk used in China is derived predominantly from the Indian Civet Viverra zibetha or the Lesser Indian Civet Viverricula indica (Anon., 1982). The secretion-producing gland of the Lesser Indian Civet is less pronounced than that of the Indian Civet but it can secrete civet musk continuously for over 10 years (Anon., 1982). An Indian Civet produces around 17-55 g of civet musk per year; a Lesser Indian Civet produces annually 30-50 g of civet musk and can do so continuously for more than 10 years (Anon., 1982). Opinions on the chemical make-up and medicinal effects of musk from musk deer and musk from the Lesser Indian Civet vary, some noting that civet musk is the most similar to musk deer musk (Liu, 1991a) and others that they are different, civet-musk oil being used in China to treat muscle pain (Xu, H., in litt., to TRAFFIC East Asia, June 2000). Farms of the Lesser Indian Civet have been set up in Zhejiang and Anhui provinces, and each civet reportedly creates annually a profit of RMB 73 (Liu, 1991b).

The male Muskrat *Ondatra zibethica* can also produce a musk-like secretion similar to musk from musk deer in its chemical make-up (Chen *et al.*, 1988). Like natural musk from musk deer, Muskrat secretion can also fight against inflammation and external bacteria (Chen *et al.*, 1988). However, the musk-like secretion from the muskrat is not used for medicine in China, but has been used to make perfume (Xu, H., *in litt.*, to TRAFFIC East Asia, June 2000).

Captive breeding, discussed later, is another proposed alternative to the collection of musk from wild populations.

PROTECTION MEASURES FOR MUSK DEER

International protection measures

As noted in Table 1 of this report, all musk deer are listed in Appendix I or Appendix II of CITES. Appendix I includes those species threatened with extinction which are or may be affected by trade. Appendix II includes those species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation.

Trade in specimens of species listed in Appendix I and II are subject to strict regulation in order not to endanger further their survival. Articles III and IV of the Convention, respectively, lay down the provisions for trade in specimens of species listed in Appendix I and II of CITES. In brief, trade in specimens of species listed in Appendix I of CITES may only be conducted under very strict regulations and may only be authorized in exceptional circumstances, such as for

scientific or educational purposes. Trade in specimens of species listed in Appendix Π of CITES is allowed subject to the issuance of CITES permits, granted in accordance with the relevant provisions of the Convention.

In addition to amending the Appendices of CITES, the Conference of the Parties (COP) also formulates recommendations to the Parties in the form of Resolutions. Decisions are also formulated and directed at specific bodies, such as the Animals Committee, the CITES Secretariat, etc. At the eleventh Conference of the Parties to CITES (COP 11), held in Nairobi 10-20 April, 2000, the Parties adopted by consensus *Resolution Conf. 11.7* on the *Conservation of and Trade in Musk Deer*. This Resolution is provided in full as Annex I to this report, but a summary of the main intent of this Resolution is included here (see box below).

Summary of Resolution Conf. 11.7 on the Conservation of and Trade in Musk Deer

Parties, particularly range, transit and consumer States, are recommended to:

Improve enforcement efforts to reduce illegal harvest of and trade in musk.

Develop identification guides and clear labeling systems for manufactured products containing musk; and,

Develop alternatives for raw musk and to explore effective techniques for collecting musk from live musk deer In order to alleviate pressure on wild populations.

Various decisions adopted to reinforce the intent of the Resolution included directives to:

the Standing Committee to review actions taken by key musk deer range, transit and consumer States to improve trade controls and to protect musk deer populations;

the Animals Committee, at its next meeting, to examine international trade in musk and its products within the context of the Significant Trade Review

the CITES Secretariat to analyse the world-wide use of musk in Asian medicine and perfumes; and,

the Parties to consider reducing export quotas until the Animals Committee has completed its significant trade review.

Protection measures in China

China has comprehensive legislation and regulations affording protection to musk deer, but enforcement and implementation of these regulations and legislation has been weak. In recent years there has been noticeable improvement in attention to wildlife crime and enforcement of protective measures, but there still remain considerable hurdles to be overcome. Existing protective measures are detailed below.

Notice on the Strengthening Protection of Musk Resources and Market Management

On 28 June 1986, 13 administrative authorities including the State Economic Commission, Customs Head Office, and the CNMA issued the *Notice on the Strengthening Protection of Musk Resources and Market Management*. This notice forbade the hunting of musk deer except with a permit from the provincial forestry administration (or higher); established quotas for the purchase of musk with a national purchase quantity not exceeding 1000 kg *per annum*; established export procedures; and appointed the Medicine Company of China as the purchasing unit for musk based on a permit system issued by the State Medicine Management Bureau (Anon., 1999). Despite these comprehensive procedures for the collection, purchase, sale, export, and use of musk, enforcement of this Notice was not effective (Fan, Z., pers. comm., to TRAFFIC East Asia, February 2000).

Regulations on the Conservation and Management of Wild Resources of Medicinal Plants and Animals (1987)

Musk deer (Moschus berezovskii, M. chrysogaster, M. fuscus, M. moschiferus, and M. sifanicus) are listed as Class II protected species under the Regulations on the Conservation and Management of Wild Resources of Medicinal Plants and Animals (1987).

Class II protected species are classified as important medicinal species with a reduced habitat and depleted resources. Hunting, collection and purchase of Class II protected species may only be carried out with prior approval (Article 7). The hunting and collection of Class II protected species is not allowed in protected areas or during the seasons when it is forbidden to hunt/collect that species (Article 8). Export of Class II protected species is allowed in limited quantities except for those species otherwise stipulated by the state (Article 15).

Wild Animal Protection Law (1988)

Musk deer are listed as a Class II protected species in China's Wild Animal Protection Law (1988). Catching or hunting of wildlife under Class II protection requires a special license from the relevant department of wildlife administration under the government of a province, an autonomous region or a municipality directly under the Central Government (Article 16).

The sale and purchase of wildlife under special state protection or the products thereof is prohibited. Where the sale, purchase or utilisation of wildlife under second class state

protection or the products thereof is necessary, the unit concerned must apply for approval by the department of wildlife administration under the government of the relevant province, autonomous region or municipality directly under the Central Government or by a unit authorised by the same department (Article 22).

As a CITES Appendix II-listed species, the export must be approved by the CITES Management Authority. China also implements stricter domestic measures for the import of CITES Appendix II-listed species and requires that a CITES import permit accompany the shipment.

Official letter No. 133 (1990)

Official letter No.133 (1990), issued by the Ministry of Forestry (now State Forestry Administration), details the correct procedures for the export of medicines containing wild animals. Attached to this letter is a list of 165 medicines containing musk, for which export must be accompanied by an export permit issued by the CITES MA. This permit must be submitted to customs for approval of export.

Official notice No. 2 (1999)

Official notice No. 2 (1999), issued by the CITES Management Authority and Head Office of Customs, details the correct procedures and permit requirements for the import, export and reexport of musk and for medicinal products containing musk. The customs codes for natural musk and medicinal products containing musk are also provided. Although the export of musk from wild populations has been prohibited since 1997, musk from captive breeding operations may be exported in "the appropriate amounts" – this amount being decided upon by the CITES MA (Fan, Z., pers. comm., to TRAFFIC East Asia 3 February 2000).

FARMING AS A SOURCE OF MUSK

Captive breeding outside China

Captive breeding of musk deer is recorded in a few countries only and has shown limited success to date. Available details on musk deer captive breeding farms are noted below. Wemmer (1998) also records small numbers of captive musk deer in Germany, Italy and the Ukraine of five, two and one musk deer respectively.

In India, captive breeding of musk deer started in 1965 (Bhadauria, 1990, and Green, 1989, in Homes, 1999). There are three farms: the Kufri musk deer farm in Himachal Pradesh; the Kanchula Kharak musk deer farm in Chamoli, Garhal, Uttar Pradesh; and the Mehruri musk deer farm near Almora, Kumaun, Uttar Pradesh (Tewari and Singh, 2000). These farms, however, reportedly do not operate very effectively (Sathyakumar *et al.*, 1993, in Homes, 1999).

Mongolia has one musk deer farm, established in 1996. The farm, run by the Mongolian Academy of Science, is located near Ulaan Baatar in the Gorkhi-Terelsh National Park and

currently has 20 - 30 musk deer. The purpose of this farm is for studying the ecology and biology of the musk deer and also to release captive-bred musk deer into their natural habitat near the farm. Although production of musk from captive-bred deer is not currently practiced, it remains an option for the future (Homes, *in litt.*, to TRAFFIC East Asia, 16 August and 12 September 2000).

Nepal has one musk deer farm located in Godavari,17 km south of Kathmandu. The farm was designed to hold 20 animals with a ratio of males to females of 1:5. In 1996, the farm had three captive animals (one male and two females - one of which was pregnant) all of which were captured in the spring of the same year. The male died after four weeks in captivity although the pregnant female successfully gave birth to one fawn. The current status of the farm is unknown (Mainka, *in litt.*, to TRAFFIC East Asia, 11 Sept 2000).

Although Russia does not currently have any musk deer captive breeding farms for musk production, there is a planned programme for captive musk deer management (Prikhod'ko, 1997 and Prikhod'ko and Ovsyanikov, 1998, in Homes, 1999). Wemmer (1998) notes that there are two zoos in Russia with populations of two and one musk deer only, and two research stations with nine and 22 musk deer. According to Prokhod'ko (1997, in Homes, 1999), management and breeding of animals in the Altai and Sayan Mountains appears promising - due to the low cost of managing and feeding. An estimated 10,000 – 15,000 musk deer could be managed profitably in small farms of 20 – 25 musk deer.

Bhutan too currently has no captive breeding operations for musk deer, but an initial assessment of musk deer captive breeding was undertaken as a joint project by the Royal Government of Bhutan and the Commission of European Communities in 1996, due to the high and increasing demand for musk in traditional Bhutanese medicine (TBM), and a reported increase in poaching of musk deer. Musk is the most important animal ingredient in TBM and is used in 30% of 206 formulas (Mainka, *in litt.*, to TRAFFIC East Asia, 11 September 2000).

Establishment of a musk deer captive breeding facility for 25 - 30 deer but initially housing 10 - 12 musk deer was estimated to cost in the region of USD 188,000 - including staff training costs, construction of the farm, purchase of transport vehicles, musk deer surveys and capture of musk deer, etc. At the time the assessment was carried out (1996), the price of musk on the international market was believed to be in the region of USD 36,000 / kg. The farm would therefore need to produce 5.2 kg of musk in order to cover start-up costs but, assuming production of 10 grammes of musk per male deer per year, over 500 male musk deer would be needed to produce this amount in one year. Production of one kilogramme of musk per year would be needed to cover annual operating costs for 10 - 12 deer. However, 10 - 12 male musk deer would likely produce only around 100 - 145g of musk per year, which was only 30-50% of the amount used annually at the time and less than 10% of potential estimated annual demand (Mainka, *in litt.*, to TRAFFIC East Asia, 11 September 2000).

In the short term and for the small numbers of deer involved, therefore, establishing a musk deer farm would not be cost effective. In the long term, and if managed properly, musk deer farms may provide a genetic safety net as part of a long-term strategy for the conservation of musk deer in the wild providing that poaching is also brought under control. However, they are unlikely to ever provide enough musk to satisfy international demand (Mainka, *in litt.*, to TRAFFIC East Asia, 11 September 2000).

The production of musk from captive-bred populations should, in theory, have several advantages, notably: authenticity of the musk can be guaranteed; the source of supply is sustainable; and the musk is accessible at a stable price. Management and breeding of musk deer in captivity however, is difficult due to their solitary nature, their territorial behaviour and excitable nature (Green, 1989, in Homes 1999). The Sichuan Institute of Musk Deer Breeding and the Musk Deer Captive Breeding Research Group of East China Normal University, however, have reported successful developments, as discussed below.

Captive breeding within China

The first musk deer farm in China was established in 1958 in Maerkang, Sichuan Province, with a base population of seven wild Forest Musk Deer *M. berezovskii*. Historically, *M. berezovskii* have been raised in Anhui, Guangdong, Guangxi, Jiangsu, Shandong, Henan, Hubei, Jilin, Liaoning and Sichuan provinces although there are now only four breeding centres for this species in China (Wang, 1998; Xu, H., *in litt.*, to TRAFFIC East Asia, June 2000). In total and including all *Moschus* species recognised in China, there are currently 12 musk deer farms in four provinces of China (Guo *et al.*, 1997). Larger farms include the Sichuan Musk Deer Breeding Institute established in 1958, the Sichuan Chuanxi Forestry Department Musk Deer Farm (1958), the Gansu Xinglongshan Reserve Musk Deer Farm (1990), Beijing Yusheng Wildlife Farm (1995) and the Shanghai Chongmingdao Musk Deer Farm (1982). In addition, there are also a number of small musk farms scattereed in the counties of Baoji, Taibai and Longxian in Shaanxi Province and Chuanxi county of Sichuan (Anon., 1999; Anon., undated.a).

Early attempts to farm musk deer in China were not successful due to a mortality rate in the region of 60-70% (Green, 1987b). Between 1959-1973, farm management was improved in the musk deer farms in Maerkang (Sichuan Province) and Foziling (Anhui Province) and the survival rate increased to between 74-90% (Green 1987b, Green 1989). The majority of musk deer bred in captivity are now *M. berezovskii*. Captive breeding of *M. moschiferus* was attempted in the 1970s in Anhui Province at the Musk Deer Breeding Centre. However, by 1986 no deer remained due to disease and mis-management. Other institutes and organisations have tried to raise *M. moschiferus* but these too have failed (Wang, 1998). *M. chrysogaster* are now raised in Gansu Province, where there is a captive population of around 200, and also at the Musk Deer Captive Breeding Research Group of East China Normal University located on Chongming Island (Wang, 1998), discussed below.

Sichuan Institute of Musk Deer Breeding

Following the establishment of the musk deer farm in Maerkang, in 1964 the JinFeng Shan Musk Deer Farm, also in Sichuan Province, was established with 178 wild musk deer which were introduced from Maerkang Musk Deer Farm. With active encouragement from the State to promote musk deer farming, the Dujiangyan Musk Deer Farm was established in 1983. TRAFFIC East Asia staff visited the Dujiangyan musk deer farm in August of 1998 and were escorted through the facility by Deputy Director Cai Yong Hua and Deputy Director Chen San, as well as Professor Li, Wang Jianming, Ms Zeng, and Mr Dai. Maerkang, JinFeng Shan and Dujiangyan now form the Sichuan Institute of Musk Deer Breeding (SIMDB) and, in 1998, encompassed 25 hectares and employed 83 staff (Cai, Y., pers. comm., to TRAFFIC East Asia, August 1998; Anon., undated.b). The SIMDB contains a nutritional laboratory for animals of medicinal value, a laboratory of analytical chemistry, an animal breeding laboratory, and a centre for the study of animal diseases established in 1983, and a bear farm established in 1985. The Institute cites its main purpose as the study of medicinal animals, while its main business is farming musk deer and bears.

'As of 1998, the SIMDB had a captive population of 1000, deer with a ratio of male:female:young at 1:1:1. Although some sources estimate China's total population of captive-bred musk deer to be around 2000 (Guo et al., 1997; Anon., 1999), the captive musk deer population in SIMDB is estimated by the SIMDB to constitute 70% of all captive musk deer in China (Anon., undated,c). On this estimate, China's total captive musk deer population may currently be calculated as around 1,430. According to the SIMDB, the musk deer population in the Institute has been augmented through the captive breeding programme, without introduction of musk deer from the wild since the 1970s (Chen, S., in litt., to TRAFFIC East Asia, 23 August 2000).

Breeding and mortality

Female *M. berezovskii* become sexually mature at 1.5 years (Chen, S., *in litt.*, to TRAFFIC East Asia, 23 August 2000). Eighty percent of births are reported to be of two fawns (Anon., undated,c). Mortality for adults and fawns is around 10 - 15% and the annual population net increase is estimated to be 15 - 20%. The highest recorded population net increase was 32%. If disease can be controlled effectively, it is estimated that annual net population increase may exceed 25% (Chen, S., *in litt.*, to TRAFFIC East Asia, 23 August 2000). The problems of captive breeding musk deer, extracting musk from live animals have been resolved, and the main problems now facing the captive breeding farms in China are disease control and increasing the production of musk (Zhou, *et al.*, 2000). The main problems facing captive-bred musk deer at the SIMDB are malnutrition and infections, with pneumonia being the most common cause of death (Cai, Y., pers. comm., to TRAFFIC East Asia, August 1998).

Musk production

The peak period of production for musk is between the ages of 3 and 10 years. Some animals yield up to 40g of musk per year and 10% of males yield around 20g of musk per year (Cai, Y.,

pers. comm., to TRAFFIC East Asia, August 1998). Average annual production of musk per male deer is 12 g dry weight (Chen, S., *in litt.*, to TRAFFIC East Asia, 23 August 1998). Yang, however, notes that 12 g is a very high average for production of musk and that older males often only produce around 3 – 5 g of musk per year (Yang, Q., *in litt.*, to TRAFFIC East Asia, 6 June 2000). The Dujiangyan Musk Deer Breeding Farm has experimented with extracting musk 3 times a year although overall production was the same as extracting musk once per year (Cai, Y., pers. comm., to TRAFFIC East Asia, August 1998).

Extrapolating from figures provided by the Sichuan Institute of Musk Deer Breeding, the SIMDB currently produces around 4 kg of musk per year, a figure supported by Zhou *et al.*, (2000), who note that production of musk from SIMDB is between 3.5 to 4 kg per year. Zhou *et al.*, (2000) also note that to produce 1 kg of good quality musk from captive breeding operations requires an investment of around RMB 100,000 to RMB 200,000 (USD 12,077 to USD 24,155).

The Institute has reported the development of a chemical marker to distinguish between musk from captive populations and musk from wild populations. Details of this chemical marker are not currently available to the public (Cai, Y., pers. comm., to TRAFFIC East Asia, August 1998).

Musk Deer Captive Breeding Research Group of East China Normal University

Information regarding the Musk Deer Captive Breeding Research Group of East China Normal University, unless otherwise indicated, was provided by the following people who escorted TRAFFIC staff through the facility: Xu Hong-fa, Department of Biology, East China Normal University; Shen Luo-ya, Shanghai CITES Management Authority; Du Te-chang, Wildlife Protection Division of the Agriculture and Forestry Bureau, Shanghai; and Zhou Qing, Keeper, Musk Deer Captive Breeding Research Group of East China Normal University.

The Musk Deer Captive Breeding Research Group of East China Normal University started its breeding programme in 1982 (Xu, H., and Sheng, H., in press) for *M. berezovskii* (Xu, H., in litt., to TRAFFIC East Asia, 21 June 00) and registered as a business in September 1998 (Anon., undated.a). The facility is located within the man-made Dong Ping Forest Park on Chongming Island which lies 40 minutes by ferry across the Yangtze River from Shanghai. It is owned jointly by the Chongming County Government and several individual investors, including the keeper.

Animals are kept under man-made forest cover behind fences that allow animals to see and smell their forest surroundings. In addition, the "flooring" within each enclosure is less abrasive than concrete, yet easy to clean, eliminating the foot diseases that plagued early musk farming efforts. Initial problems in breeding the high altitude *M. berezovskii* in low altitude Shanghai were overcome after ten years research although the herd size still remains small (Xu, H., and Sheng, H., in press). Founder stock included 15 wild musk deer and, as of 1998, the facility held 65 deer (Anon., undated,a). Research at the facility has found that the breeding enclosure

needs to be large enough to allow the male to chase the female as this will lead her to oestrus (Xu, H., and Sheng, H., in press). The wooded compound could accommodate up to 1,000 musk deer, and the facility hoped to introduce stocks from the Sichuan Institute in order to bolster numbers and genetic diversity. Commercial musk production is believed to be possible once the resident population reaches 300. Whereas the main impediment to expansion of the operation used to be disease, husbandry had been improved to the point that mortality is low. The chief constraint now is obtaining musk deer. Purchase of a deer from other farms costs between USD600 and USD1,000 per animal, not including transportation.

Increased dietary protein, and the addition of vitamins (0.15%), minerals (1%) and trace elements (0.15%) have been shown to enhance the volume of musk production and to decrease the age when musk production begins (Anon., 1995b, Huang *et al.*, 1998). The musk deer eat more than 370 different types of plants and over 220 plant types are fed for disease prevention (Anon., 1995b). Every year, the feed of male musk deer is fortified 1-2 months before and after the musk secretion period (May to July), and 1 month before and after the mating/breeding period (October to December). Feed is also fortified for female musk deer after mating, through pregnancy and while weaning fawns (Anon., 1995b).

Current research at the facility focuses on: increasing the oestrus rate and the pregnancy rate of the female; increasing the survival rate of the baby deer; reducing the death rate of musk deer caused by diseases; increasing the number of herds of musk deer; developing an index system for selective rearing; and increasing the volume of musk produced by each male.

Production of musk has averaged over 20g per male musk deer for the past three years (Anon., undated,a) and has been pronounced by a Shanghai Chinese medicine company as having the same chemical composition to that of wild musk deer. The facility plans to merge with the Sichuan Institute of Musk Deer Breeding (Anon., undated,a) and is currently seeking foreign investors to help them reach their goal of 1,000 deer by the year 2003.

The secretion and extraction of musk from captive-bred musk deer

The quantity of musk captive-bred musk deer secrete is closely related to its age and physical condition, the size of its musk sac, its health and nutritional intake, the climate, and the season musk collection is carried out (Yan, 1985; Anon., 1995b; Huang *et al.*, 1998). In a study of Siberian musk deer in Foziling Musk Deer Farm, Anhui Province, Yan (1985) found that musk deer in poor physical condition secrete only 41-46% of musk produced by a healthy male. The physical condition of the musk deer is closely related to its weight and nutritional intake and the larger the male musk deer, the more musk it can secrete. Musk deer with a musk sac of an inner diameter greater than 5cm can secrete the most musk. Those with a sac of 4-5 cm are of the middle category, and those with a sac of diameter under 4 cm are considered small, producing 39-45% of the musk produced by those of the large category. Musk produced by a sick musk deer is 49-53% of that produced by a healthy musk deer. Removal of the testicles causes the musk sac to shrink and prevents the production of musk (Yan, 1985).

Other factors influencing production of musk include the type of shelter provided, the use of stimulants and the nutritional intake. An enclosure with trees providing shade can stimulate the metabolism of musk deer and increase musk secretion. In addition, injection of a stimulant $Androteston - testerone\ propionate$ at a time other than the secretion period causes the testicles and the musk gland to swell. Secondary secretion of musk deer injected with this stimulant produced 40 - 57% of the quantity of musk collected at the first secretion during tests in 1977. The chemical makeup and clinical effectiveness of musk produced with the help of the stimulant is the same as naturally secreted musk. At musk deer farms, nutritional intake is fortified to improve physical condition, especially after rutting and mating when they are physically exhausted (Yan, 1985).

Extraction of musk

The male musk deer is first caught by the hind legs and then held with its head secured and its abdomen facing upwards. No anaesthetic is administered but alcohol is applied to first sterilize the musk sac opening before inserting a small spoon into the sac to a depth not exceeding 2.5 cm. Once the musk is extracted, a small quantity of penicillin or anti-inflammatory agent is applied to the sac opening to prevent infection (Anon., 1995b). Unskilled extraction of musk can cause necrosis in the structure of the musk gland, halt the production of musk, cause stress to the musk deer and, in some cases, may be fatal (Kurtis Pei, pers. comm., to TRAFFIC East Asia, April 1999).

Projected production

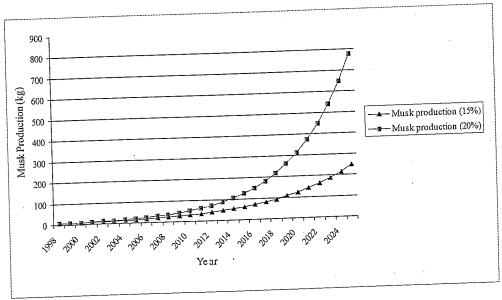
Production of musk from China's musk deer farms is not yet at a stage where it can meet domestic demand, estimated at between 500 – 2000 kg per annum. As of 1998, the Sichuan Institute of Musk Deer Breeding had 1000 musk deer in captivity - estimated to be 70% of China's total captive-bred musk deer population. The population is estimated to have a net increase of 15 – 20% per year. Adult male musk deer reportedly constitute a third of the Institute's captive population and, on average, reportedly produce 12 g per year per individual. Although the CNMA (Anon., 1999) and Guo et al., (1997) estimate there to be in the region of 2000 musk deer on China's farms, TRAFFIC's calculation of projected musk production from China's farms is based upon figures provided by the Sichuan Institute of Musk Deer Breeding because this is the only institute for which a ratio of male to female to young is provided.

Nonetheless, a number of assumptions are needed to calculate China's maximum production of musk from captive populations: first, it is necessary to assume that musk is extracted from all males regardless of age or function in the farm; second, one must assume that other farms in China have the same annual net increase in their captive populations. Finally, average production of musk must be assumed to be the same for all males in all farms. Although 12 g / year (dry weight) has been noted as being more than average (Yang, Q., *in litt.*, to TRAFFIC East Asia, 6 June 2000), calculations will be based on this average of 12 g as provided by the Sichuan Institute of Musk Deer Breeding.

Extrapolating from the figures provided by the Sichuan Institute of Musk Deer Breeding, total production of musk from China's musk deer farms would be in the region of 6 kg per year (Annex II), although Zhou *et al.*, (2000), note that total production from China's farms is between 7 and 10 kg. As China's domestic demand for musk in TCM is estimated to be in the region of 500 – 2000 kg per year, production of 6 kg would meet only between 0.3% and 1.2% of domestic demand. Even taking into account the fact that musk is often adulterated with other substances (Green, *in litt.*, to TRAFFIC East Asia, 17 July 2000), it is clear that production of musk from China's farms is a long way from meeting annual demand in China. Explanation of the discrepancy between demand for and production of musk may lie in one or several of the following reasons: demand for musk is being met with the use of synthetic musk rather than natural musk; demand is being met in part by illegal hunting of China's musk deer (no hunting permits for musk deer in China have been issued since 1989) or / and through illegal imports of musk into China.

As concerns future demand, it would appear, based on current figures, that China's farms are still a long way from meeting domestic demand. Assuming a net increase of 15% for captive populations, and bearing in mind the above assumptions, the maximum amount of musk that China could hope to produce by the year 2025 would be 247 kg. Taking an annual net increase of 20% for captive populations, the maximum amount of musk that China could hope to produce by 2025 is 778 kg, Figure 2 and Annex Π.

Figure 2
Estimated increase in musk production, assuming an annual net population increase of 15% and 20%, 1998-2025



As noted above, these projected musk production figures are based upon a number of assumptions. Although on paper they look impressive, in reality these figures are likely overly optimistic (Yang, Q., in litt., to TRAFFIC East Asia, 6 June 2000; Zhang, E., in litt., to TRAFFIC East Asia, 21 June 2000); the production of 247 kg of musk would require a total captive population of over 62,200 musk deer (and over 20,500 male musk deer); the production of 778 kg would require over 196,000 musk deer in captivity (and over 64,800 male musk deer) (Annex II). Although advances have been made in the captive breeding of musk deer, a projected 31- to 98-fold increase in the captive population by the year 2025 is indeed very high; when TRAFFIC East Asia visited the SIMDB again in July 2000, the captive population in this Institute was stated as being 1000 - the same as in 1998 - with the same projected net population increase.

Primitive captive breeding techniques and a lack of knowledge of reproduction of musk deer have had a negative impact on the long-term development of musk deer breeding (Zhou, *et al.*, 2000) and since captive breeding of musk deer was first attempted in China, the total captive population has remained around 2000 (Zhang, E., *in litt.*, to TRAFFIC East Asia, 21 June 2000). Sheng (1996) also notes that captive breeding operations are still at the same level as they were in the 1960s, although captive breeding should be encouraged further.

Although SIMDB is promoted within China as a model for the captive breeding of musk deer, advances made at this Institute are not widespread amongst other captive breeding farms. Communication and exchange of information between musk deer farms, although crucial, is lacking and advances made in one farm are not shared with another. Guidelines for the captive breeding of musk deer have yet to be developed (Zhou, *et al.*, 2000).

SUMMARY AND DISCUSSION

Assessing the status of musk production in China is plagued with difficulties: the status of musk deer in the wild is vague; the exact number of musk deer captive breeding farms is unknown; the population of captive-bred musk deer is unclear; and production of medicines containing or purporting to contain musk perplexing. Nonetheless, it is possible to gauge a general idea of the situation within China regarding musk deer and musk production based on the available information.

Estimates for China's wild population of musk deer vary considerably and it is not always clear how such estimates were reached. Broad estimates for China, however, indicate that the population has declined from over three million in the 1950s to between 200,000 and 300,000 in the 1990s. Despite China's clear long-term commitment to the conservation of musk deer through the enactment of various protective measures, populations of musk deer are continuing to decline due to illegal hunting.

Musk deer are listed as Class II protected species under China's Wild Animal Protection Law (1988) and hunting of musk deer requires a permit issued by the provincial wildlife management authority. No such permits have been issued since 1989 although capture of animals to augment

captive populations is allowed with the requisite permits. Export of musk from wild populations is prohibited although allowed for musk from captive breeding operations; medicinal derivatives containing musk are allowed with relevant permits from the CITES Management Authority and Customs. Despite these relatively comprehensive measures, in reality, enforcement of wildlife trade regulations is undermined by a lack of communication and co-ordination between wildlife management authorities and the medicinal and enforcement authorities in China.

At the international level, musk deer are afforded some level of protection in international trade with all populations being listed in CITES Appendix I or II; China's populations are listed in Appendix II. International trade records for CITES-listed specimens, maintained by WCMC, show that, from 1991 - 1998, China imported 9 kg of raw musk but exported millions of medicinal derivatives purporting to contain musk. If these derivatives do contain musk, it is likely to have been obtained illegally and thus, CITES export permits should not have been issued, particularly as the impact upon musk deer populations must be significant. It is more likely, however, and supported by results of analysis in Taiwan of medicines from China purporting to contain musk, that the vast majority of these derivatives contain synthetic or counterfeit musk rather than genuine musk. If no genuine musk is contained in these derivatives a CITES export permit is not required. There is clearly a lack of transparency in the manufacture of medicines purporting to contain musk, a situation reflected in the impossibility of analysing international trade data with any level of confidence. Accurate labelling of medicines, noting whether genuine and / or synthetic musk is used, and standardised units of measure for recording trade in musk and its derivatives would greatly facilitate the task of the national CITES Authorities in assessing the legality and impact of trade on musk deer populations, and would enable the monitoring of international trade in musk and its derivatives.

Recognition of declining musk deer populations and of the importance of musk as a medicinal ingredient have also resulted in the development of alternatives to musk and increased attention to captive breeding of musk deer. Synthetic musk, officially approved by China's Ministry of Public Health in November 1993, has the potential to alleviate pressure on wild populations if supported by *in-situ* conservation, but is not the only alternative to genuine musk. When reliable population estimates have been established in China and on-going illegal hunting brought under control, established and enforced quotas could provide a sustainable means of providing musk from wild populations. Capture and subsequent release of live wild musk deer to extract musk is another means of obtaining musk, and one recommended in *Resolution Conf.* 11.7 on the *Conservation of and Trade in Musk Deer*, whilst providing an incentive to rural communities to protect musk deer and their habitat. Musk from civets and also from the Muskrat are natural alternatives to musk from musk deer, although musk deer musk is believed to be more effective than these alternative forms of musk.

Concern for the long-term availability of musk for medicinal use also led to the establishment, in the late-1950s, of captive breeding operations for musk deer. Demand for musk within China is estimated to range from between 500 to 2000 kg *per annum* – although it is unknown whether these figures take into account the common phenomenon of musk being adulterated. Assuming the average weight of a musk pod to equal 25 g - which is thought to be very high (Yang, Q.,

in litt., to TRAFFIC East Asia, 6 June 2000), then one year's demand would require the harvest of around 20,000 to 80,000 male musk deer. However, due to the indiscriminate methods used to catch musk deer, a far higher number of musk deer would actually be killed if China's annual domestic demand was to be met through the hunting of wild musk deer. The conservation consequences of uncontrolled poaching particularly with indiscriminate methods is immense – not just for musk deer but also for other animals that may be caught in traps.

Theoretically, captive breeding of musk deer could provide a guarantee of the purity and legality of the musk. However, despite recent advances in musk deer captive breeding, China's musk deer captive breeding farms are unlikely to ever produce large quantities of musk. In total, and based upon figures provided by the Sichuan Institute of Musk Deer Breeding, China's musk deer farms currently hold around 1,400 musk deer. Erring in favour of a higher yield of musk, annual production from China's musk deer captive breeding operations is currently about 6 kg and therefore meets only between 0.3% and 1.2% of demand. Even assuming that these estimates for demand account for adulterated musk, it nonetheless remains clear that captive breeding operations are a long way from meeting demand within China for use in traditional systems of medicinal health care. If production could be increased, a guaranteed source of unadulterated musk could contribute, in small part, to China's needs. At present, however, a large proportion of the little musk that is produced on the farms is exported to Japan.

Although captive breeding can play a role in alleviating pressure on wild populations for certain species, such as for Sika deer Cervus nippon for pilose (velvet) antler, captive breeding of musk deer is plagued with difficulties including disease and high mortality. The production of one kilogramme of good quality musk from captive breeding operations requires an investment of around RMB 100,000 to RMB 200,000 (USD 12,077 to USD 24,155) (Zhou et al., 2000). The profit margin, if any, is extremely small. While the production of musk is an important economic consideration, it is unlikely that these farms will ever produce sufficient quantities of musk to meet domestic demand. Given the high prices that musk fetches on the domestic and international markets, the relative ease of smuggling musk and the low levels of enforcement, the role that captive breeding of musk deer can play in alleviating pressure on wild populations is therefore questionable when carried out in isolation of *in-situ* conservation activities. Captive breeding of musk deer, however, could serve as a genetic 'safety' net for wild populations. Research of properly managed, self-sustaining captive populations may provide valuable information to benefit the species in the wild. But these ex-situ efforts must be supported by the necessary in-situ conservation measures to protect wild musk deer populations. Furthermore, even if musk deer captive breeding operations are able to achieve greater success, successful captive breeding alone does not assure maintenance of healthy wild populations. Sika deer, again, are a good example: despite successful captive breeding of Sika deer over many centuries in China for pilose antler, the total global population in the wild is no more than 1000 animals and all sub-species in China are listed in the IUCN Global Red List as either Endangered or Critically Endangered (Baillie and Groombridge, 1996).

Communication between musk deer farms, musk deer researchers and exchange of information on captive breeding is crucial but severely lacking. Most research concentrates upon the

composition of musk and medicinal theory, but little research is conducted into reproduction of musk deer, prevention and treatment of disease and increasing musk production, and most musk deer farms learn by their mistakes as they go along. Advances made by one farm are therefore unlikely to be known about in other farms, and there are currently no guidelines for the establishment and running of such farms (Zhou, et al., 2000). If musk deer captive breeding farms are to contribute to the conservation of musk deer in the wild then it is imperative that a system for exchanging information between farms is in place and standardised guidelines for operating these farms developed and implemented.

Communication between the relevant authorities responsible for wildlife conservation and regulation of wildlife trade and the medicinal authorities is crucial but also severely lacking. Despite the protected status of musk deer in the wild, collection of musk appears to be on-going by the medicinal authorities. Dialogue is urgently needed and could be facilitated by the establishment of a committee on wildlife conservation and traditional health care. Further research is also required to determine the amount of raw unadulterated musk required *per annum* for use in traditional health care systems within China, and to determine the quantities of raw musk currently used in the production of patented Chinese medicines for consumption within China and abroad.

RECOMMENDATIONS

Recognition of declining populations of musk deer in the wild and of the importance of musk as a medicinal ingredient have resulted in various measures being enacted to protect musk deer in China, including the establishment of musk deer captive breeding farms. *In-situ* measures are impressive on paper, but in reality enforcement is inadequate; *ex-situ* measures are not linked to *in-situ* conservation and production of musk in these captive breeding farms is insufficient to contribute to *in-situ* conservation.

There is a severe lack of communication and coordination between government agencies involved in the protection and management of musk deer and government agencies involved in the use of musk. The resulting conflict of interests has already and will continue to affect musk deer populations, and indeed other natural resources protected by law but required for use in traditional medicines.

The long-term sustainability of natural resources of medicinal use is crucial to the development of traditional medicine. There is therefore a vested interest for wildlife management authorities and medicinal authorities in China to work together towards protecting these resources and limiting use to within sustainable limits. The following recommendations are put forward bearing in mind the need for the long-term medicinal needs of China's people and the resulting need for the conservation of natural resources. These recommendations also draw upon discussions and recommendations put forward at the meeting of the Biodiversity Working Group of the China Council for International Cooperation on Environment and Development, July 2000, also attended by TRAFFIC East Asia.

Cross-sectoral co-ordinating body

The primary recommendation of this report is to establish a cross-sectoral co-ordinating body to strengthen communication and complementary activities among the medicinal manufacturers and authorities, wildlife management authorities and enforcement authorities. Once established, this cross-sectoral co-ordinating body should hold regular meetings and may wish to consider activities such as exchange of personnel between the wildlife management authorities and medicinal authorities.

Researchers at the musk deer captive breeding farms should also be encouraged to participate in this forum and a mechanism devised whereby knowledge can be shared between farms, and guidelines for running such farms established and implemented.

Funding mechanisms could also be explored whereby those agencies benefiting from musk resources could provide financial assistance to those responsible for protecting musk deer in the wild.

Research

Research is required to:

- determine the present status, and to monitor population trends, of musk deer in the wild in China.
- determine the quantity of raw unadulterated musk required *per annum* for preparation of crucial medicines for consumption within China;
- further understanding of musk deer in captive breeding farms so that knowledge gained may contribute to the conservation of musk deer in the wild.

Alternatives

Where possible, practitioners of traditional medicine are encouraged to explore alternative ingredients for those species for which an adequate supply cannot be obtained sustainably from wild or captive-bred populations. This may include medicinal ingredients from non-threatened species and/or chemically derived synthetics.

Labelling

In accordance with *Resolution Conf. 11.7* on the *Conservation of and Trade in Musk Deer*, the medicinal authorities in China are recommended to develop clear labelling systems for manufactured products containing or purporting to contain musk.

Standardised units of measurement for recording trade

Standardised units of measurement are required for musk derivatives in international trade in order to facilitate the task of CITES Authorities in determining the legality and impact of trade in musk derivatives on musk deer populations and to facilitate the monitoring of international trade.

Enforcement

Enforcement authorities should be apprised of existing regulations regarding the harvest, trade and use of musk. Also in accordance with the Resolution adopted at COP 11, investigations of illegal trade in musk into and within China are recommended.

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ANNEX I

RESOLUTION CONF. 11.7 ~ CONSERVATION OF AND TRADE IN MUSK DEER

AWARE that all musk deer species are included either in Appendix I or Appendix II of the Convention; RECOGNIZING that musk deer are native to Asia but that natural musk and products containing musk are used and traded worldwide and, therefore, that conservation of musk deer is a global concern;

NOTING that the status and trends of musk deer populations and the domestic demand for musk in range countries are inadequately documented;

FURTHER NOTING that continued illegal trade in raw musk derived from wild musk deer undermines the effectiveness of the Convention;

AWARE that, if Parties and States that are not yet party to the Convention do not take action to eliminate the illegal trade, poaching may cause declines and even extirpation of certain populations;

RECOGNIZING that long-term solutions for the protection of musk deer require the adoption of substantive and measurable actions designed to ensure sustainable use;

RECOGNIZING that strengthening technical cooperation between range and consumer States and financial support would contribute to more effective musk deer conservation;

THE CONFERENCE OF THE PARTIES TO THE CONVENTION

URGES all Parties, particularly musk deer range and consuming countries and those through which musk deer specimens pass in transit, to take immediate action in order to reduce demonstrably the illegal trade in musk deriving from wild musk deer by:

- a) introducing innovative enforcement methods in range and consumer States and, as a matter of priority,
 strengthening enforcement efforts in key border regions;
- pursuing the development of a clear labelling system for products containing musk, and the development and dissemination of forensic methods to detect natural musk in medicinal and other products;
- encouraging all range States and consumer States that are not party to CITES to accede to it at the
 earliest possible date in order to improve international trade control of raw musk and products
 containing musk;
- d) working with musk consumers to develop alternatives for raw musk in order to reduce demand for natural musk, while encouraging the development of safe and effective techniques for collecting musk from live musk deer; and
- e) developing bilateral and regional agreements for improving musk deer conservation and management, strengthening legislation and strengthening enforcement efforts;

RECOMMENDS that manufacturing and consumer States cooperate in the development and distribution of identification guides for manufactured products containing musk to assist with enforcement efforts; and CALLS on the Parties, international aid agencies, intergovernmental organizations, and non-governmental organizations, as a matter of priority, to provide financial and technical assistance to range States to conduct population surveys, and surveys of domestic markets for musk deer, including both legal and illegal trade.

ANNEX II

ESTIMATED PRODUCTION OF MUSK, BASED ON 1) 15% INCREASE IN A CAPTIVE POPULATION OF MUSK DEER AND 2) 20% INCREASE

Year	Population	Males	Musk	Population	Males	Musk
			production			production
			(kg)			(kg)
1998	1,430	472	6	1,430	472	6
1999	1,645	543	7	1,716	566	7
2000	1,891	624	7	2,059	680	8
2001	2,175	718	9	2,471	815	10
2002	2,501	825	10	2,965	979	12
2003	2,876	949	11	3,558	1,174	14
2004	3,308	1,092	13	4,270	1,409	17
2005	3,804	1,255	15	5,124	1,691	20
2006	4,374	1,444	17	6,149	2,029	24
2007	5,031	1,660	20	7,378	2,435	29
2008	5,785	1,909	23	8,854	2,922	35
2009	6,653	2,195	26	10,625	3,506	42
2010	7,651	2,525	30	12,750	4,208	50
2011	8,798	2,904	35	15,300	5,049	61
2012	10,118	3,339	40	18,360	6,059	73
2013	11,636	3,840	46	22,032	7,271	87
2014	13,381	4,416	53	26,438	8,725	105
2015	15,389	5,078	61	31,726	10,470	126
2016	17,697	5,840	70	38,071	12,564	151
2017	20,351	6,716	81	45,686	15,076	181
2018	23,404	7,723	93	54,823	18,092	217
2019	26,915	8,882	107	65,787	21,710	261
2020	30,952	10,214	123	78,945	26,052	313
2021	35,595	11,746	141	94,734	31,262	375
2022	40,934	13,508	162	113,680	37,515	450
2023	47,074	15,534	186	136,417	45,017	540
2024	54,135	17,865	214	163,700	54,021	648
2025	62,256	20,544	247	196,440	64,825	778

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The TRAFFIC Network is the world's largest wildlife trade monitoring programme with offices covering most parts of the world. TRAFFIC is a programme of WWF - World Wide Fund For Nature and IUCN - The World Conservation Union, established to help ensure that trade in wild plants and animals is not a threat to the conservation of nature. It works in close co-operation with the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The TRAFFIC Network shares its international headquarters in the United Kingdom with the World Conservation Monitoring Centre.

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