ON THE SCENT:

CONSERVING MUSK DEER -

THE USES OF MUSK AND EUROPE'S ROLE IN ITS TRADE

VOLKER HOMES

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Photograph credit: H.-W. Schuldei, Leipzig Zoo.

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ON THE SCENT: CONSERVING MUSK DEER - THE USES OF MUSK AND EUROPE'S ROLE IN ITS TRADE

by Volker Homes

Credit: Frank Meyer and Bruno Schneider, Leipzig Zoo

Young Siberian Musk Deer *Moschus moschiferus*

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EXECUTIVE SUMMARY

There are at least four and possibly six or more species of musk deer *Moschus* spp. To date, their taxonomy has not been resolved conclusively and little is known about their biology. Musk deer occur in at least 13 countries in South Asia, East Asia, Southeast Asia and the eastern parts of Russia.

All musk deer species have been included in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1979. Populations of Siberian Musk Deer *Moschus moschiferus* occurring in the countries of the Himalayan region (Afghanistan, Bhutan, India, Myanmar, Nepal and Pakistan) were included in Appendix I, although some experts consider these populations to be of Himalayan Musk Deer *Moschus chryogaster* and Black Musk Deer *M. fuscus*. All other musk deer species are listed in Appendix II. Knowledge of their distribution is incomplete and the population sizes of the different species are uncertain in several cases. In many range countries, laws to protect musk deer and their habitats exist, yet in practically all countries in Asia where musk deer occur, wild populations are declining, mainly because of the high demand for musk. China and Russia are the countries inhabited by the largest numbers of musk deer. The population size of musk deer in China is approximately 600 000 individuals, but the basis for this figure is unclear. Data on the sizes of musk deer populations in Russia are in part contradictory. According to various experts, musk deer populations in Russia have fallen by around 50% in the last 10 years as a result of over-exploitation. The causes of this have been the difficult socio-economic conditions in Russia, which have prompted poaching and illegal trading, leading in turn to uncontrolled hunting of the deer, in contrast to strict regulation of their exploitation in the Soviet Union.

Traditionally, musk pods are harvested by killing the deer, although it is possible to obtain musk from a live deer. The high value of musk has often been an incentive for the illegal hunting of musk deer. Only male musk deer produce musk, at the rate of about 25 g of musk, per animal, per year.

In East and South Asia, musk has been used as an ingredient in medicine and as a perfume for about 5000 years. Today it is contained in about 300 pharmaceutical preparations in traditional Chinese and Korean medicine, as a sedative and a stimulant to treat a variety of ailments relating to the heart, nerves, breathing and sexuality. Today musk remains one of the most expensive natural products on the market, much more valuable even than gold (gold price: US$10/g in August 1998). End-consumers in the perfume industry of Europe or on the trading markets in Japan face retail prices of about US$30-50/g.

The aim of this study is to summarise information on musk deer and musk itself as a background to describing the international musk trade and the demand for musk, and to determine the significance of Europe's role in global trade. It is part of a comprehensive international analysis of the trade in, and use of, musk in medicine and in the perfume industry which TRAFFIC is conducting in a number of countries.

A total of 35 countries were involved in the legal export of musk products during the period 1978-96, according to CITES annual report data. Musk deer occur in nine of these countries: the remaining 26 countries were re-exporters. Over the same period, 42 countries imported musk and musk products.

According to official CITES data, East Asia and Southeast Asia are the major traders and consumers of musk products, primarily for medicinal purposes. China was the major legal exporter of such products from 1978 to 1996. North America and Oceania also trade in musk, also primarily in derivative products for use in medicine. In contrast, during the same period, Europe mainly imported unprocessed musk and France, together with South Korea, Hong Kong, Japan, Singapore and Canada (a possible mistake in the data), were the major importers of raw musk. Hong Kong and Singapore were also major re-exporters of raw musk, as was Cambodia, while the major primary exporters of legally traded raw musk, from 1978 to 1996, were Mongolia, the Soviet Union, Russia, Kyrgyzstan and Uzbekistan. Trends in the trade in raw musk indicate a dramatic increase in the export figures after the break-up of the Soviet Union in 1992.

During the 1990s, international trade in musk increased in a number of European countries. In western Europe, from 1978 to 1996, Germany, France and Switzerland were the only countries trading in musk and virtually the entire volume of imported musk originated from the Soviet Union and Russia. From 1994 to 1996, approximately 60 kg of unprocessed musk was imported by Germany, 99% of which was re-exported to Hong Kong and Singapore. The German role as a trading centre for raw musk increased after the break-up of the Soviet Union. In the period 1989-95, Switzerland imported approximately 12 kg of unprocessed musk, 92% of which was re-exported to France and South Korea. France imported approximately 97 kg of unprocessed musk from 1980 to 1995. Only 7% of the 97 kg was re-exported, primarily to Hong Kong.

The impacts of hunting and trapping result in an estimated three to five musk deer killed for every male deer with a sufficiently large musk gland. Since an average of 40 male deer with sufficiently large glands are necessary to produce each kilogramme of musk, this equates to the hunting of about 160 deer in total. In turn, this means that amounts of raw musk imported legally by France, Germany and Switzerland over the past two decades represent the deaths of tens of thousands of musk deer.

The use of natural musk in the European perfume industry has declined in the 1990s, as the cost of its inclusion in perfumes is now generally considered too high. Assuming that the musk imported to France was used primarily in the European perfume industry, the share of musk used in perfumes by France constituted between 5% and 15% of the unprocessed musk in trade globally from 1978 to 1996. A further decline in the use of musk in the European perfume industry is anticipated for the future, since newer synthetic musk compounds are increasingly replacing natural musk in perfumes.

Natural musk is also used for homeopathic medicine in Europe, but to an extremely limited degree: less than one thousandth of the total world trade volume in unprocessed musk, 1978-96, was for this end use.

Illegal trade in musk in various countries in Europe (e.g. UK, Netherlands, Belgium, Germany) is centred primarily on medicines used in traditional East Asian medicine (TEAM), mainly because of trade without appropriate CITES permits, but unprocessed musk has been seized in France. According to CITES annual report data for 1978-96, there were no musk derivatives recorded in trade to European countries, excepting reports of some from China in 1990-92, which were not confirmed by European countries. Most products which contained musk or claimed to contain it which appeared on the market in Europe during that period were probably illegal, therefore.

The most important action to reduce the use of natural musk, mainly in medicines but also in perfumes, in both musk deer range and non-range countries, would be the increasing of public awareness and knowledge of the conservation concerns surrounding musk deer, among all user-groups. Use of musk from wild deer should also be reduced through increased substitution with synthetically produced musk, natural musk from farmed deer and musk taken from live musk deer captured in the wild. **Recommendations** for action to promote the future conservation of musk deer are based on the following areas of focus:

Improvement of scientific information on the conservation status of musk deer

Accurate assessments of musk deer populations and their conservation status are crucial to effective conservation of the species. Therefore, studies of the species should be undertaken urgently in the known range States - Afghanistan, Pakistan, Bhutan, Myanmar, Vietnam, North and South Korea, Russia, Kazakhstan, Kyrgyzstan (possible range State), China, Mongolia, India and Nepal. Most urgently, these are needed in China, Mongolia and Russia, because these are the range countries where exports and use of musk occurs in the most significant quantities. This report recommends the results of such assessments to be presented to the 11th meeting of the Conference of the Parties to CITES. The taxonomy of various musk deer species should be clarified, in particular because recommendations for legal actions under CITES are established at species level.

Investigation of harvest, trade and demand in musk deer range countries

Surveys of the domestic markets for musk deer in China, South Korea, India, Nepal, Vietnam, Mongolia and Russia, should be undertaken as priorities because these domestic markets seem to be of high relevance, but the demand for musk, and its harvest and legal and illegal trade should be surveyed in all musk deer range countries. For example, the level of demand for musk and the characteristics of the market for traditional East Asian medicines containing musk should be examined and studies are needed to clarify the scale of illegal trade in musk along Russia's eastern border. This report recommends the results of such surveys be presented to the 11th meeting of the Conference of the Parties to CITES.

Improvement of legal protection for musk deer in range countries

Appropriate measures to protect musk deer need to be taken in musk deer range countries, including the further establishment of protected zones; classing species and subspecies of musk deer as protected by law, where this is not already the case; revising the regulatory system for the exploitation of musk deer and export of musk in Russia; establishing such a system in Kazakhstan and Kyrgyzstan (if this is a range country); and encouraging the accession to CITES of the musk deer range countries Bhutan, Kazakhstan, Kyrgyzstan, and North Korea.

Sustainable use initiatives and farmed deer

The Chinese policy on musk deer farming needs to be reviewed and, where applicable, developed into an economic and species-appropriate management concept, while plans for the extraction of musk from captive musk deer in Russia should be supported and, if economically feasible, used in private business with management plans and initiatives. Projects that can demonstrate sustainable harvests of musk from

farmed and/or wild animals should be promoted as models to emulate. China and Russia should exchange knowledge and share experience relating to the management and breeding of musk deer on farms and make the same available to other relevant countries, for example, North and South Korea.

Regulation of trade in musk in non-range countries

Importing countries should be required to assist source countries to safeguard and monitor wild musk deer populations, by means of financial or technical assistance. While all CITES Parties trading raw musk internationally should enforce all CITES provisions pertaining to musk, the role of Cambodia in the international musk trade should be singled out for further investigation and the significance of Hong Kong, Singapore, Taiwan, Japan and Cambodia in the international trade in, and use of, medicines containing musk should be examined in greater detail. Enforcement problems relevant to the international trade in musk derivatives should be detected and eliminated - for example, proposals for labelling of musk specimens and products containing musk should be developed jointly with the traders and authorities in the countries of origin and forensic techniques should be developed and shared among CITES Parties to determine the presence or absence of musk in derivatives.

Use of musk and musk products in Asian medicinals, perfumes and homeopathic products

The level of Asian medicinal consumption of musk needs to be ascertained to better understand the existing and expected market needs. Until the presence or absence of genuine musk in Asian medicines is clarified, all items that claim to contain musk should be traded with CITES permits. Simultaneously, research on musk substitutes for use in TEAM needs to be encouraged.

Although it seems likely that the demand for musk in the perfume industry in Europe is decreasing, this requires monitoring, particularly since there are reports that natural musk is used in the Russian perfume industry. Reported use of natural musk in Chinese and Arabian perfume manufacture also requires monitoring. Perfumes that contain natural musk should be subject to permitting requirements when in international trade, as are other products containing the ingredient, but since the amount of musk used in homeopathic medicine is very low it is not recommended that homeopathic products containing musk need CITES permits when in international trade.

INTRODUCTION AND BACKGROUND

This study aims to summarise information on musk deer and musk itself as a background to describe the international musk trade and the demand for musk, and to determine the significance of Europe's role in the global trade. It is part of a comprehensive international analysis of the trade in, and use of, musk in medicine and in the perfume industry which TRAFFIC is conducting in a number of countries.

The word "musk" derives from the ancient Indian word *Muskáh* meaning "testicles". This probably alluded to the musk sac of the male musk deer which is located close to the male genitals. The musk sac contains the musk substance which is secreted into the sac by musk glands.

In western Europe the term "musk" conjures up images of strength, sensuality and erotic attraction. In some European countries many people may be thinking of the large and powerful Musk Oxen *Ovibos moschatus* of the Arctic latitudes. Few people know that the musk aroma originates from a small member of the deer family Moschidae, found in South Asia, East Asia, Southeast Asia and the eastern parts of Russia. Musk is so sought-after that it is one of the most expensive substances derived from any animal in the world: the price of musk in Europe in the 1990s has reached three to five times that of gold.

Musk is known to have been used in medicine and as a fragrance for over 5000 years and was praised by Mohammed in Hadith (the major source of guidance for Muslims after the Qur'an) when describing paradise (6579: "...the water's fragrance is better than musk"). The natural musk aroma exceeds most other similar-smelling animal and plant constituents in intensity, persistence and fixative properties. For this reason, musk is used not only as a fragrance but also as a fixative for other fragrance. In the past, musk has been confused with castoreum from Beavers *Castor fiber,* as the Sanskrit word for musk is *Kasturi* (Leeser, 1961). The Ancient Greek medicine of Hippocrates treated infertility with castoreum, but the musk "which kings receive and use as gifts" was introduced to Western medicine by Arab doctors, and most notably Serapio. Musk was prized as a tonic for the heart and mind, for chronic headaches and for stimulating sex drive.

The most important market for musk products now is in Asia, for traditional East Asian medicine (TEAM). Musk is included in about 300 pharmaceutical preparations in traditional Chinese and Korean medicine as a sedative and a stimulant, to treat a variety of ailments of the heart, nerves, breathing and sexuality and is therefore one of the most commonly used animal products in this type of medicine (Mills, 1998). Musk has also been used for some hundreds of years in the perfume industry in Europe (Pilz, 1997 and Müller, 1991). During the 1990s, international trade in musk increased in a number of European countries.

Although it is possible to obtain musk from a live deer, traditionally musk pods are harvested by killing the deer and the high value of musk has often been an incentive for illegal hunting of musk deer. High levels of international trade have been of concern and all musk deer species *Moschus* spp. have been included in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1979, with the purpose of improving control of international trade. The populations of the Siberian Musk Deer *Moschus moschiferus* in Afghanistan, Bhutan, India, Myanmar, Nepal and Pakistan (which Green (1998) considers to be of Himalayan Musk Deer *Moschus chryogaster* and Black Musk Deer *M. fuscus*) were included in Appendix I at that time, with the effect that international commercial trade in musk deer or parts of musk deer from specimens of wild origin from these populations is prohibited. All other musk deer species were listed in Appendix II and, as such, international trade is allowed but strictly monitored, according to the provisions of the Convention. An export permit issued by CITES authorities in exporting countries is a minimum requirement for specimens of Appendix II-listed musk deer to be exported. Notwithstanding the species' CITES listing, knowledge of the biology of *Moschus* spp., their numbers in the wild and the degree to which they are threatened are prerequisites for determining effective measures for their conservation in the wild. The taxonomy of the musk deer species

Moschidae remains unclear, however, and biologists are only beginning to understand their ecology and behaviour (Green, 1998). According to some experts in Russia, the number of musk deer in Siberia and in the Russian Far East has fallen dramatically since the beginning of this decade (Anon., 1993; Poyarkov and Chestin, 1993; Prikhod'ko, 1997 and Prikhod'ko and Ovsyanikov, 1998). These populations are estimated to have declined by as much as 50% within a period of less than ten years. Green (1986 and 1989) describes a decline in populations of musk deer in India and Nepal, also. According to the IUCN/SSC Deer Specialist Group, the numbers of most musk deer populations in those countries are diminishing (Wemmer, 1998).

Owing to the decline of most musk deer populations, it is considered necessary to attain an overview of the worldwide demand for, and trade of, musk and musk deer products. Only once this is gained can realistic strategies for the conservation of wild musk deer and the sustainable use of musk be developed.

METHODOLOGY

Research for this study on the trade in, and use of, musk from musk deer was carried out by TRAFFIC Europe-Germany between January and July 1998. In this report, the word "musk" is used to mean natural musk from musk deer *Moschus* spp.

Consultation of Customs statistics in order to analyse international trade in musk deer products was not possible, as the trade is classed with trade in a number of other commodities (*"Ambergris, castoreum, civet, cantharides, bile, glands and other animal substances for manufacturing drugs")* under tariff heading number 0510 00, according to the internationally used Harmonised Commodity Description and Coding System. Therefore, TRAFFIC Europe-Germany analysed all data relating to international trade in specimens of musk deer reported by CITES Parties in annual reports. These annual reports are compiled by the World Conservation Monitoring Centre (WCMC). Trade of a CITES-listed specimen between two Parties is required, according to the terms of the Convention, to be reported by both the country of export (or re-export) and country of import and each Party is also required to submit an annual report of such trade to the CITES Secretariat. The analysis of musk trade data conducted by TRAFFIC Europe-Germany, based on these annual reports, spanned 18 years (1978-96) and comprised 612 records. Each record included the year of trade; species in trade; CITES Appendix listing; country of import; country of (re-)export; country of origin of the specimen; specification of terms and units; purpose of the transaction and source of trade. This information was analysed to document trade flows, and to assess the conservation impact on musk deer, but it was recognised that this methodology will reflect imperfections inherent in the system of annual reporting by CITES Parties. The imperfections include, for example, the fact that many Parties do not submit annual reports at all, that others submit far too late and that most reports finally submitted are incomplete. There are many possible reasons for the fact that annual reports are incomplete and that the correlation between export and import figures is poor. One reason is that some Parties, for example, Russia, report the trade quantities for which CITES documents were issued (A. Vaisman, pers. comm., June 1998), while others (for example, Germany, France and Switzerland) follow the recommended CITES procedure and report the actual trade quantities imported or exported. For these reasons, the trade data were analysed by separating the reported import and (re-)export figures before carrying out careful cross-comparison between reported exports and imports.

It should be noted that not all the countries that traded musk during the period under investigation were Parties to CITES. The musk deer range States of North Korea, Bhutan, Kyrgyzstan (a possible range country), and the non-range States of Yugoslavia and Taiwan are examples of non -Parties which trade in musk products. There was therefore no annual report of CITES-listed trade for these States for analysis and their share of international trade in musk was assessed using the annual reports of their trading partners.

TRAFFIC Europe-Germany consulted with CITES Management Authorities in Germany, Switzerland and France, respectively the *Bundesamt für Naturschutz* (Federal Agency for Nature Conservation) in Bonn, the *Office Vétérinaire Fédéral* in Bern, and the *Ministère du Territoire et de l`Environnement, Direction de la Nature et des Paysages* in Paris, to confirm the accuracy of the import and export data on musk for these countries. The *Zollkriminalamt* and the *Zollfahndungsamt* (Customs Criminal Investigation Department) in Cologne were also consulted about the illegal trade in musk deer products in Germany. In Switzerland, such enquiries were addressed to the *Office Vétérinaire Fédéral* and the Swiss Customs administration in Bern, while in France the *Direction de la Nature et des Paysages* and the *Direction National du Renseignement et des Enquêtes Douanières* in Paris were consulted. Information on legal and illegal trade of musk deer products in Russia was provided by TRAFFIC Europe-Russia. It was not possible to confirm the accuracy of the export data on musk for the former Soviet Union since all documentation dated prior to 1992 has reportedly been lost in the course of administrative changes (A. Vaisman, pers. comm., June 1998).

Analysis of trade in musk to Germany, Switzerland and France revealed that only a few middlemen are involved in trade of significant shipments of musk (i.e. of several kilogrammes each). These middlemen were interviewed as part of research for this report.

To verify information about the use of musk in the perfume and cosmetics industry, TRAFFIC Europe-Germany consulted companies and associations of companies in the aromatics and perfume industries in Germany, Switzerland and France. The research focused on Germany, France and Switzerland because perfume manufacturing has a long tradition in these countries and is economically of great significance compared to the industry in other European countries. The three countries referred to are also the only ones in Europe found to be legally importing musk according to CITES permits. To document the use of musk in the pharmaceutical sector, well-established manufacturers of homeopathic medicines and other relevant companies in Germany, Belgium, Switzerland and the UK were consulted.

Information about the keeping and breeding of musk deer in zoos was gathered during interviews with personnel at Leipzig Zoo, which is presently the only zoo in Europe outside Russia that is breeding musk deer, in this case Siberian Musk Deer.

Finally, TRAFFIC Europe-Germany consulted literature on musk, the musk deer and the use of musk. It is possible to estimate the numbers of musk deer harvested, according to known amounts of musk in trade. For this study, such estimates have been made using the following average values: weight of musk in one musk gland: 25 g (Green, 1989); number of musk deer killed: three to five animals taken to obtain one male musk deer with a sufficiently large musk gland (Green, 1986; Jackson, 1979 and Prikhod'ko, 1997).

THE MUSK DEER: BIOLOGY, DISTRIBUTION, CONSERVATION STATUS AND PROTECTION

Morphology

Musk deer *Moschus* spp. are small members of the deer family with a head to body length of 86-100 cm, a height at the shoulder of 53-80 cm and a weight of 13-18 kg (Zhivotshenko, 1988). Musk deer do not have antlers, but males and females possess clearly elongated upper canine teeth that project far below the lower lip. The length of male canines usually reaches six to eight centimetres, and in rare instances as much as 10 cm, and they are used in fights between rivals.

The rear part of the body is more powerfully built than the forequarters, with the back being curved and hind legs longer than the forelegs. Musk deer movement appears more like jumping than running. Their

toes are large for their body size and can be spread to find secure footing in mountains and on snow. Their coat is thick and includes brittle guard hairs. Individual hairs contain air-filled cells for better insulation (Green, 1985).

Taxonomy

Musk deer have been classified with deer in the Cervidae family (Flower, 1875 and Heptner and Naumov, 1961), but today they are grouped together by many scientists into their own separate family, the Moschidae (Brooke, 1878; Flerov, 1952; Groves and Grubb, 1987 and Whitehead, 1972). As already stated, musk deer taxonomy remains debatable. While it was previously assumed that one to three species existed (Green, 1986; Groves, 1975 and Grubb, 1982), there are now thought to be at least four and possibly six or more species (Green, 1998; Groves and Grubb, 1987 and Groves *et al*., 1995). There is, however, broad agreement over the distinctions made for the following four species and their occurrence (Wemmer, 1998):

- Siberian Musk Deer *Moschus moschiferus* (Russia, Kazakhstan, Kyrgyzstan, China, Korea and Mongolia)
- Forest Musk Deer *M. berezovskii* (China and Vietnam)
- Himalayan Musk Deer *M. chrysogaster* (Afghanistan, China, India, Nepal and Pakistan)
- Black Musk Deer *M. fuscus* (Bhutan, China, India, Myanmar and Nepal). Some maintain that this is a subspecies of *M. chrysogaster*.

Ecology and behaviour

Habitat and ranging behaviour

Musk deer inhabit steep, forested or shrub-covered slopes, mainly in the sub-alpine zones of mountain regions. Dense undergrowth of rhododendron, bamboo and other shrubs form the typical habitat (Bannikov *et al*., 1978 and Green, 1987a). Use of the habitat depends upon the availability of cover, food and other factors: musk deer are very shy and solitary animals that may not become active until dusk. In Kedernath, in Northern India, Himalayan Musk Deer are primarily active at night, on exposed alpine meadows (Green, 1998).

Musk deer are essentially sedentary with individual home ranges of 13-22 ha (Green, 1998, Harris and Guiquan, 1993). Previous studies of Himalayan Musk Deer in the Himalayas show no evidence of any seasonal movement of the animals, such as to lower altitudes in winter (Green, 1987a). Bannikov *et al*. (1978) report, however, that musk deer in Russia may migrate up to 35 km when snow in winter deprives them of their usual food and shelter.

Credit: H. Mix

Male Siberian Musk Deer *Moschus moschiferus* in winter

Male musk deer are highly territorial, tolerating only female musk deer within their home ranges and defending their home range against other males of the species (Green, 1998), while female territories may overlap. In studies in Nepal it was found that, in regions where the population density of musk deer is high (23 individuals to 50 ha), the home range of one male overlaps with parts of the home ranges of five females but not with parts of the home range of another male. However, in studies in northern India (Green, 1995 and 1998) it

was found that in cases where the population density was low (five to six individuals/km^2) the home ranges did not overlap as much as when densities were high.

Communication between animals

Solitary behaviour is typical for small forest ruminants, such as musk deer, which are guided primarily by their olfactory sense. Olfactory signalling between musk deer is highly developed (Lai and Sheng, 1993). So-called "latrine sites" (areas of droppings), urine markings and the musk scent of males, as well as scent from other glands found around the hoof and tail areas, are used for marking (Green, 1987c and Sokolov and Prikhod'ko, 1979 and 1983).

The function of the musk scent in chemical communication is not entirely understood. Observations of red- or pink-stained and sweet-smelling patches of urine in snow indicate that the musk of the male is probably emitted in the urine, while the urine of females, by contrast, is amber-coloured and does not have any noticeable smell to humans (Green, 1987c). The scents could be used for territorial marking by animals and at the same time express something about the individual status of animals. Fights between rivals would in this way be kept to a minimum and females would learn more about potential reproductive partners.

Reproduction

Musk deer breed seasonally. The rut extends from November to early January and the young are born from May to June after a gestation period of 178-198 days. The period of gestation increases with the size of the species, from the Forest Musk Deer, the smallest species, to the Siberian Musk Deer, to the Himalayan Musk Deer, the largest species and that with the longest gestation period (Green, 1989). Litter size ranges from one to three young. Twin births predominate in Forest Musk Deer and Siberian Musk Deer, while single births are most common in Himalayan Musk Deer.

The birth weight of musk deer varies between about 400 g and 600 g, depending on the species. In their first two months, the young musk deer, like all deer species, are "nursed offspring" concealed in the undergrowth and suckled by their mothers. At the age of about two months they begin to follow their mothers and are weaned (Green, 1987a).

The young grow rapidly, become independent of their mothers by the age of six months, and reach sexual maturity at 18 months of age. Female musk deer are capable of breeding after their first year (Green, 1987a and 1989). This fact is conducive to quick growth of a population of musk deer, relative to other large mammals, given suitable environmental conditions: the musk deer populations of Russia were brought to the brink of extinction through over-hunting in the early part of the twentieth century and were subsequently able to recover within a few decades.

Credit: Frank Meyer and Bruno Schneider, Leipzig Zoo

Female and young Siberian Musk Deer *Moschus moschiferus*

Food

The food of musk deer consists primarily of leaves of trees, shrubs and forbs. They have a preference for easily digestible nutritious foods that are high in energy content, rich in protein and low in fibre (Green, 1987b and Kholodova and Prikhod'ko, 1984). In northern India, forbs and parts of trees and woody shrubs form the main part of the diet in summer and winter. In winter the musk deer can also survive on poorer

quality diets, for example, mainly lichens *Usnea* spp. which, while low in proteins, are very high in energy and easily digested (Green, 1987b and Negi, 1996). When the snow is deep, arboreal lichens and evergreen rhododendrons may constitute the only available sources of nourishment for musk deer. Musk deer can climb into trees to graze on lichens and leaves otherwise out of reach.

Predators

Musk deer have a number of natural predators. Depending on the range, their main predators may include the Wolverine *Gulo gulo*, Grey Wolf *Canis lupus*, Leopard *Panthera pardus*, Tiger *Panthera tigris*, Snow Leopard *Unica unica*, Lynx *Lynx lynx*, Fox *Vulpes vulpes* and Yellow-throated Marten *Martes flavigula*. The young are also attacked by large birds of prey (Green, 1987a, Kozhechkin, 1994 and Zhivotshenko, 1988). Predators do not, however, have a significant impact on the size of the musk deer population. In the region of the Altai and Eastern Sayans in Russia, musk deer form up to 50% of the diet of the Yellow-throated Marten but, nevertheless, the martens in these regions remove only about 8-12% of the overall population of musk deer (Bannikov *et al*., 1978 and Prikhod'ko, 1997). Musk deer detect approaching danger in part though their sense of hearing (F. Meyer, pers. comm., April 1998 and Zhivotshenko, 1988).

Distribution and population

The distribution of musk deer extends through the forested mountains of eastern Asia, from the Arctic Circle in Siberia in the north, to the north-eastern edge of Mongolia and Korea and further southward across China, away from the Gobi Desert, to Vietnam, and Myanmar continuing as far as the southern Himalayas in India, Pakistan and Afghanistan (see **Figure 1**). In Central Asia, musk deer occur in Kazakhstan, possibly in Kyrgyzstan, and the south of Russia (Dao, 1977; Flerov, 1952; Green, 1986 and Whitehead, 1972). Musk deer mainly inhabit altitudes of above 1000 m. In the Himalayas, the animals' range extends in parts up to the tree line at an altitude of 4200 m, but in the northern parts of their range, musk deer may occur at much lower altitudes.

The accuracy of the estimates of the size of musk deer populations varies greatly in the different regions (Wemmer, 1998). Only in very few countries are population estimates based at least in part on systematic counts carried out in selected areas and extrapolated to larger distribution ranges: this method of estimating population sizes was used in the Soviet Union. Overall the population of all musk deer species may be estimated to be between 400 000 and 800 000 individuals.

The following information is taken mainly from the IUCN/SSC/Deer Specialist Group (Wemmer, 1998):

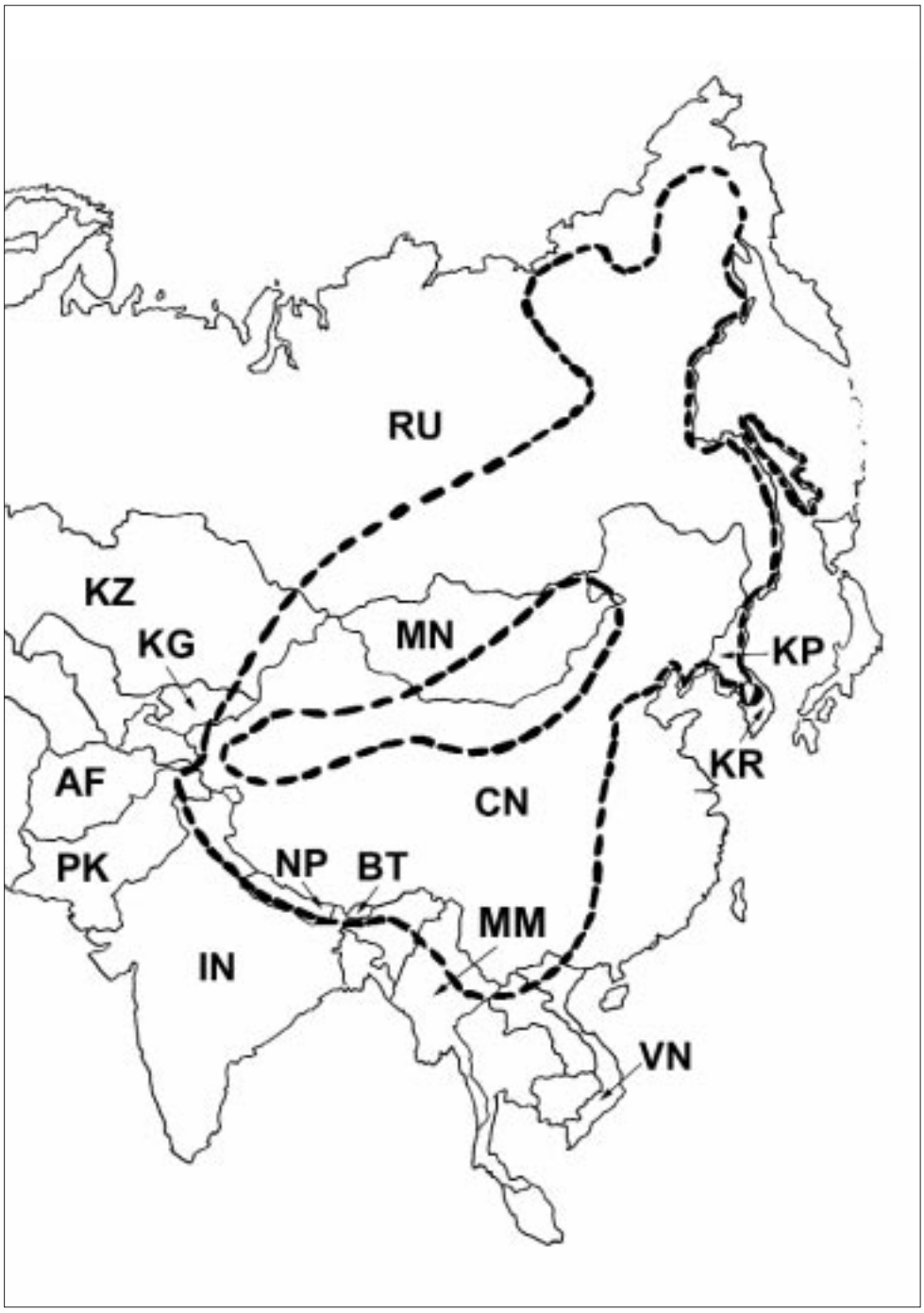
- Himalayan Musk Deer populations in **Afghanistan** and of Black Musk Deer in **Bhutan** are estimated to be small.

- The population of Forest Musk Deer in **China** is estimated to number approximately 600 000 individuals, but the basis of this figure is unclear. This species is most widespread in China and constitutes the largest population of all musk deer species in China. The other three musk deer species also live in China, but only in certain provinces of the country and they are markedly less abundant than the Forest Musk Deer (Ohtaishi and Gao, 1990 and Sheng and Ohtaishi, 1993).

- In **India**, Himalayan Musk Deer inhabit parts of Kashmir, Himachal Pradesh, the northern part of Uttar Pradesh, Sikkim and Arunachal Pradesh. The species is more common in the Eastern Himalayas because the habitat of the animals has been less disturbed there. Black Musk Deer occur in the provinces of Assam and Sikkim.

Figure 1

Range of musk deer (*Moschus* spp.) according to Corbet and Hill (1992); Dao (1977); Flerov (1952); Green (1986); Wemmer (1998) and Whitehead (1972)



Credit: Jürgen Matijevic and Alexandra Heyse, WWF Germany

Notes: Outer boundary: border of musk deer range; inner boundary: non range area.

AF: Afghanistan; BT: Bhutan; CN: China; IN: India; KG: Kyrgystan; KP: North Korea; KR: South Korea; KZ: Kazakhstan; MM: Myanmar; MN: Mongolia; NP: Nepal; PK: Pakistan; RU: Russia; VN: Vietnam

- Siberian Musk Deer populations in **North and South Korea** are considered to be near extinction. Information on their present distribution and population size is, however, lacking.

- Populations of Siberian Musk Deer in **Mongolia** are believed to be small owing to hunting of these animals.

- Nothing is known about the small population of Black Musk Deer in **Myanmar** (Salter, 1983).

- In **Nepal**, Himalayan Musk Deer are widely distributed across the mountainous parts of the Himalayas. Within protected areas numbers of the deer are increasing, while outside the protected areas they are continuing to decline. Black Musk Deer also occur in the Everest region.

- In **Pakistan**, Himalayan Musk Deer are found in only a small part of the mountainous regions of the Western Himalayas (Ahmad and Ghalib, 1975).

- In the **territory of the former Soviet Union** only the Siberian Musk Deer species occurs. The subspecies *M. m. moschiferus* is widely distributed throughout Eastern Siberia and in the Russian Far East, from the Altai Mountains in the west to the Kolymskiy Mountains in the east. *M. m. parvipes* occurs in the Ussurisk region of the Russian Far East and four populations of the Sakhalin Musk Deer *M. m. sachalinensis* inhabit the southern half of Sakhalin Island.

  TRAFFIC Europe-Germany has no information about estimates for population sizes of musk deer in Kazakhstan (where they occur in the easternmost part, in the Altai province) and in Kyrgyzstan (where it possibly occurs), but the numbers would be very low (O. Tsaruk, Y. Chikin, T. Brangina and A. Vaisman, pers. comms to TRAFFIC Europe-Germany).

- Populations of Forest Musk Deer occur in the north-east area of **Vietnam**. The population levels are declining here in all areas because of illegal hunting (Corbet and Hill, 1992 and Duc *et al.*, 1990).

Population in the Soviet Union and Russia

Information on musk deer populations in Russia differs widely. Between 1990 and 1996 there were no official counts of musk deer in the territory of the former Soviet Union (A. Vaisman, *in litt*. to TRAFFIC Europe-Germany, June 1998). Between 1979 and 1990 musk deer were counted in parts of their range, but no official data for the total population of musk deer in the Soviet Union at this time are available.

According to official figures from the State Service for Statistics on Hunting Resources (1997), populations of Siberian Musk Deer in Russia, in 1996, stood at 153 200 and in 1997 at 154 000. These figures are based on sample counts and extrapolations. However, some musk deer experts in Russia have a totally different opinion of the number of musk deer remaining in Russia (Anon., 1993; Poyarkov and Chestin, 1993 and Wemmer, 1998). The Russian population of the species is assumed to be stable, according to the State Service for Statistics on Hunting Resources (1997).

Bannikov *et al*. (1978) estimated the population of Siberian Musk Deer in the former Soviet Union at 100 000, based on a mean population density of 0.6 animals per km^2 (densities of up to 20 animals per km^2 are obtained in optimum habitats). However with the disintegration of the Soviet Union, the population has apparently declined considerably and is currently estimated to total around 50 000-60 000 individuals, with approximately 29 000-30 000 in the Altai and Sayan region; 18 000-19 000 around Lake Baikal; 5000-6000 in Siberia; 4000-5000 in the Russian Far East and 300-350 on Sakhalin Island

(Wemmer, 1998). About 1500-2000 of the 4000-5000 deer in the Russian Far East live in protected areas, 70% of them in just one enclave, the Sikhote-Alin biosphere reserve.

According to Prikhod'ko (1997), musk deer numbered no fewer than 200 000 at the beginning of the nineteenth century, but their economic exploitation peaked in the middle of that century - in 1855, official records show that 81 200 males were captured - and by the end of the century the species was believed to be threatened with extinction. Between the 1920s and the 1940s, however, the population recovered noticeably. At the end of the 1960s, the population of musk deer in the Soviet Union stood at 80 000-115 000[1] (see **Footnotes**). In the 1980s, the musk deer population in the former Soviet Union continued to grow and its range extended further (Prikhod'ko 1997). At that time, about 50-60% of the world population of Siberian Musk Deer was found in present-day Russia. Prior to 1988, the population of musk deer in the Soviet Union is believed to have numbered some 160 000-170 000 animals (Prikhod'ko, 1997). From 1989 to 1993, however, this population is thought to have declined to 90 000-100 000. Since there was a great demand for musk at the end of the 1980s, at a time when political changes in the region precluded adequate trade controls, there was a rapid increase in poaching of musk deer in the late 1980s and 1990s in Russia (Prikhod'ko, 1997; Prikhod'ko and Ovsyanikov, 1998 and TRAFFIC International, 1994). A total of 300-380 kg of musk was traded from eastern Russia from 1989 to 1996, of which an estimated one-third was estimated to have come from illegally captured animals (see **Illegal trade in Europe** and *Hunting in the Soviet Union and Russia***)**. Since this amount of musk is equivalent to a harvest of 23 000-26 000 male musk deer or a total harvest of 90 000-104 000 musk deer, the number of musk deer in Russia would accordingly have declined by 50-70% in the period 1990-93, (Prikhod'ko, 1997). For 1996, Prikhod'ko estimated a musk deer population of 53 000-60 000 (see **Table 1**).

Faleyev (in Anon., 1993) reports a catastrophic population collapse of up to 80% in the Altai region from 1986 to 1992, and estimated that the 50 kg of musk traded legally in 1990 and 1991, plus the amount traded illegally, from just that region, must have come from at least 10 000 animals. Prikhod'ko (1997) made random sample counts in the Altai Mountains in 1995 and, based on these, suggested a ten- to twelve-fold decrease in musk deer population density compared with 1989 and expressed the concern that increased fragmentation of populations could cause genetic damage to the musk deer.

Conservation status and protection

The conservation statuses of species of musk deer are recorded as follows in the *IUCN Red List of Threatened Animals* (IUCN, 1996):

Siberian Musk Deer: Vulnerable (VU)
Forest Musk Deer: Lower Risk (nt)
Himalayan Musk Deer: Lower Risk (nt)
Black Musk Deer: Lower Risk (nt)

Vulnerable (= VU) means: threatened because of an observed, estimated or anticipated reduction in population in the past or future. Lower Risk signifies that the species is not included in the three categories of "threat" but "nt" (= near threatened) classifies them as approaching a threatened level.

All musk deer species have been included in the Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1979. Populations of Siberian Musk Deer *Moschus moschiferus* occurring in the countries of the Himalayan region (Afghanistan, Bhutan, India, Myanmar, Nepal and Pakistan) were included in Appendix I (although Green (1998) considers these populations to be of Himalayan Musk Deer *Moschus chryogaster* and Black Musk Deer *M. fuscus*), while all other musk deer species are listed in Appendix II.

There are primarily two forms of threat that have caused depletion of populations of musk deer throughout their range, more recently with increasing effect in Russia and China. The first is loss of habitat and the second is hunting of the animal to obtain musk (Wemmer 1998; Green, 1986; Jackson, 1979 and Prikhod'ko, 1997).

Loss of habitat as a threat

Musk deer habitat is converted for settlements, agriculture and other types of land use, under pressure from a constantly growing human population.

Green (1986) reported that the overall distribution of musk deer south of the Himalayas has not decreased markedly in the twentieth century, but that the populations today inhabit significantly smaller areas and that their occurrence is more fragmented than at the beginning of the century. This is likely to be a result of the dramatic increase in human population, particularly in India and Nepal. The habitats of musk deer in the subalpine region of the Himalayas are increasingly used for harvesting firewood and as pasture land (Harris, 1991). This causes the loss of the understorey of vegetation which is of particular importance to musk deer for food and shelter against predators. According to Green (1986), the area of potential habitat for musk deer south of the Himalayas is about 50 000 km^2. With an identified optimum population density of three to six individuals/km^2, this area would provide space for 200 000 animals. The same author suggests, however, that the mean population density is similar to that in Russia (Bannikov *et al*., 1978) and is around 0.6 individuals/km^2, which places the total population of musk deer in the southern Himalayas at no more than 30 000 animals.

Habitat loss is also mentioned as a factor threatening musk deer in the Russian Far East, where intensive timber harvest and the frequent burning of forests are destroying their habitats (Prikhod'ko, 1997 and WWF-Deutschland, 1998).

Hunting as a threat

Musk deer have been hunted by humans for thousands of years. However, the meat is not considered tasty and even the hide is not particularly valuable as the hairs fall out easily (Heptner and Naumov, 1961). The overriding cause for the intense hunting of musk deer has always been the demand for musk.

Jackson (1979) describes the traditional hunting methods of some of the mountain peoples in western Nepal. Musk deer and Snow Leopards are killed with poisoned bamboo *Arundinaria* spp. spears. Selling just a small number of musk glands yielded sufficient income to meet a substantial portion of the annual living costs of a whole family in Nepal in the 1970s.

In other parts of their range, musk deer are hunted with modern guns, snares, traps and dogs. They may either be hunted as the prime target for their glands, or shot incidentally in hunting other animals (Ivanovic, 1996). Investigations in the Himalayas showed that particularly large numbers of female and young deer are killed during musk deer hunts. These may later be used as bait in traps or as dog food. In considering the impact of hunting on musk deer populations, it is important to bear in mind the fact 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; Jackson, 1979 and Prikhod'ko, 1997).

Hunting in the Soviet Union and Russia

In the Soviet Union, hunting of musk deer was subject to a licensing system and used to be controlled centrally from Moscow. Annual musk deer population counts were carried out, on the basis of which shooting quotas were fixed (A. Vaisman, pers. comm., March 1998). The counts were carried out by

experts and were reportedly well-organised. About 4-6% of the estimated musk deer population, i.e. 5500-6000 animals, including some 35-40% males was harvested each year (Prikhod'ko, 1997). Up until the early 1980s, musk deer were chiefly a target for amateur hunters in the Soviet Union.

In Russia today, hunting and poaching are the prime causes for the reduction of musk deer (Prikhod'ko 1997). The animals are mainly hunted during the winter, from October to March. Poachers use guns and dogs and increasingly snares, which are set at a density of 100-600/km^2. Legal hunting for musk deer is regulated through licences, as it was in the Soviet Union (Anon., 1993), but in a less centralised system. In principal, local district hunting authorities report animal population figures every year, after the winter counts. Via the provincial governments, the information is then transferred to the State Service for Calculating Hunting Licences, based at the Russian Ministry of Agriculture and Food in Moscow. A scientific commission establishes the number of hunting licences (number of animals to be shot) allowed for each of the provinces and districts for the next hunting season and a licence per deer may then be sold by the district hunting authorities to hunters (A. Vaisman, pers. comm., June 1998).

In practice, the dissolution of the Soviet Union led to a rapid increase in poaching of musk deer in the late 1980s and 1990s in Russia and to lax enforcement of trade controls (Prikhod'ko 1997; Prikhod'ko and Ovsyanikov 1998; and TRAFFIC International, 1994). Demand for musk at the end of the 1980s in Russia was high (see ***Population in the Soviet Union and Russia***). According to Prikhod'ko (1997), specifically the transfer of power from Moscow to regional authorities, the lack of monitoring of hunting, and the official decision to allow the capture of animals with snares all contributed to conditions fostering intense hunting of musk deer in Russia. It is believed that, even in remote areas, 25-30% of the overall population may be removed by hunting (including poaching), at a rate exceeding that of reproduction in the population. Major population declines in the Altai region between the mid-1980s and mid-1990s were linked to intensive hunting (see ***Population in the Soviet Union and Russia***). In the early 1990s, the most intensive commercial hunting and poaching took place around the Baikal-Amur railway, in the Amur region and around Khabarovsk, resulting in heavily depleted populations (see **Table 1**).

Table 1

Number of musk deer, recorded quantity of musk traded and estimated numbers of musk deer killed to supply the musk in Russia and in the Russian part of the Soviet Union

Area	Musk deer population in 1988 (in thousands)	Musk recorded in trade 1989-93 (kg)	Estimated number of musk deer killed, 1989-93, (in thousands)	Estimated musk deer population in 1996 (in thousands)
Altai	42-45	122	35	16-18
Sayan, Krasnoyarsk	38-40	30	20	14-16
Irkutsk Region, Zabaikal	48-50	54.3	25	17-18
Amur Region, Khabarovsk, Primorskiy	24-28	33.5	20	4-5
Yakutia, Magadan Region	5-7	unknown	2	2-3
Island of Sakhalin	0.3-0.4			0.3
Total	**160-170**	**240**	**90-100**	**53-60**

Source: Prikhod'ko, 1997.

As **Table 1** shows, Prikhod'ko (1997) reported, (according to official data), that about 240 kg of musk were traded in the Soviet Union/Russia from 1989 to 1993. He further estimated that from 1989 to 1996,

the overall quantity of musk traded legally and illegally in the Soviet Union/Russia amounted to about 350-380 kg. This latter quantity was estimated to represent the capture of 23 000-26 000 male animals, or a total of 90 000-104 000 musk deer.

Credit: H. Mix

Skull of a musk deer

The banning of all hunting of musk deer for five years in the Altai Mountains (1992-96) and in the Krasnoyarsk region is reported to have led to a partial decrease in poaching and to have shifted the hunting and trading of musk to the Transbaikal region and the Russian Far East (Prikhod'ko, 1997). Fomenko (*in litt.* to TRAFFIC Europe-Germany, 1997) reported that, in the 1995/1996 hunting season, about 70 kg of musk from approximately 3500 male musk deer were available for sale in the regions of Khabarovsk, Primorye, Amur and the Jewish Autonomous Region.

TRAFFIC Europe-Germany has no information about levels of legal and illegal hunting of musk deer in Kyrgyzstan and other countries of the former Soviet Union.

Legal protection of musk deer species

There are protected areas in many countries within the range of musk deer. It is unclear to what extent these protected areas contribute to preserving musk deer but, in Nepal, musk deer populations in protected areas are steadily increasing while the species decreases elsewhere in the country (Wemmer, 1998). In India, musk deer occur in 23 protected areas, but these cover only 5% of musk deer habitat in India (Sathyakumar, 1992).

The following information on the legal protection afforded musk deer in their range States is mainly summarised from Wemmer (1998) and Green (1998):

- **Afghanistan:** Musk deer are not legally protected.

- **Bhutan:** Musk deer are totally protected by Royal Decree. Poachers may legally be shot on sight.

- **China:** Musk deer are protected under the *Wild Animal Protection Law* 1988 as a Category II key species. Such Category II species may be taken in the wild only under permit granted by the provincial authority. In 1988, the Quinghai Provincial Government promulgated a special emergency notice under its regional wildlife protection laws to draw attention to the threat posed to musk deer species and to strengthen protection of the species. However, there are no indications that the protection of musk deer in China is effective in aiding the species. Efforts to establish a network of protected areas to conserve the Giant Panda *Ailuropoda melanoleuca* have indirectly contributed to the protection of Forest Musk Deer, since both species occur in the same habitat.

- **India:** Musk deer have been fully protected since 1972 under the federal *Wildlife (Protection) Act* and cannot legally be hunted.

- **Kazakhstan**: There are no provisions protecting musk deer (Krever *et al.*, 1998).

- **Kyrgyzstan**: There are no provisions protecting musk deer (Krever *et al.*, 1998).

- **North Korea:** Musk deer were designated "Natural Monument No. 216" in 1968 and are protected as a result. A Musk Deer Preservation Council was established in 1978 under the auspices of the Korean Wildlife Preservation Association.

- **Mongolia:** Musk deer have been protected as an endangered species since 5 June 1995.

- **Myanmar:** Musk deer have been protected since 1994 under the *Nature and Wildlife Law*.

- **Nepal:** Musk deer have been totally protected since 1973 under the *National Parks and Wildlife Conservation Act*.

- **Pakistan:** There are no provisions protecting musk deer.

- **Russian Federation**: All hoofed mammals (Ungulata) fall within the scope of the national hunting law which in part also regulates animal protection (A. Vaisman, pers. comm., June 1998). Musk deer are hunted under licence, as explained (see *Hunting in the Soviet Union and Russia*), but regulations vary between krays (administrative territories). In some krays there are harvest quotas for musk deer and in others a prohibition of the hunting of musk deer. Regulations can vary from one year to another.

  The Sakhalin Musk Deer, a rare subspecies, is the only musk deer to have been included in the Russian Federation's Red List. The national Red List in Russia is also intended to constitute a list of those species afforded legal protection in the country (Ivanovic, 1996). In the 1980s only about 5-8% of the Sakhalin Musk Deer population was found in protected areas[2] (see **Footnotes**).

- **Vietnam:** Musk deer have been protected by law since 1963 and any exploitation is prohibited.

THE MUSK GLAND AND MUSK AS A PRODUCT

The gland of the musk deer is approximately walnut-sized and is situated in the prenuptial region of the male animal, between the abdomen and the genitals. The gland is four to six centimetres long and 3.5-4.5 cm wide. The opening of the gland is only a few millimetres from the opening of the urethra. In the Himalayas, most musk is produced in the months from May to July, immediately prior to the autumn rut. At this time the yellow musk secretion flows via ducts into the musk sac. It ripens here within about a month into a scented red-brown substance. When removed from the animal, the gland is dried, whereupon the red-brown creamy substance within blackens and becomes granular and powdery (Mukerji, 1953). Musk may enter the trade either as whole pods or as the granular red-brown contents of the pod, which is also known as musk grain.

Male musk deer produce musk from the age of 12-18 months onwards (Green, 1989). Most musk is produced by animals between three and eight years of age, averaging 25 g of musk, per animal, per year. In captivity, males produce little musk after the age of 14 years but the ability to produce musk is retained until the age of 20 years. On average, 18 g (10 g dry weight) of musk can be harvested annually from animals kept in captivity (Green, 1989).

A distinction is made in the trade between four basic grades of musk: (i) the traditional highest grade, Tonkin musk, from China and Tibet; (ii) Assam or Bengal musk from India; (iii) Russian musk; and (iv) Bukharan musk from the area of the former Soviet Union (Falbe and Regitz, 1995).

Musk remains one of the most expensive natural products in the world today. At the end of the 1970s, the market value of musk reached US$45 000 per kg, or two or three times its weight in gold (Green, 1986).

In the 1850s, by comparison, musk had been worth only a quarter of the price of gold and there have indeed been large price fluctuations over the years. Musk has a very high value for the people living in the range of musk deer. The proceeds from selling 50 g of musk (mean weight of two musk pods) were reported as sufficient to provide a Nepalese family living in a remote mountain region with at least a year's income (Blower, 1974, in Green, 1989). Of 60 families studied in a village in western Nepal in the 1970s, 25 were involved in musk deer poaching and for 20% of the families involved, hunting for two-and-a-half months was sufficient to secure income for a year in Nepal and more money than a soldier could earn in the army over three years (Jackson 1979). Harris (1991) maintained that the value of a musk pod exceeded the annual income of a shepherd in Tibet.

Credit: Michael J.B. Green

Musk deer pods

Musk is often adulterated because of its high value: to increase the weight, the musk is supplemented with dried blood, liver or spleen, dried gall or the bark of certain trees. Less sophisticated adulterations contain lead shot or tobacco. According to Green (1989), the major Japanese importer of musk had taken to testing the purity of musk using gas-liquid chromatography. According to Vaisman (1998), glands from Russia have been traded since the mid-1990s in frozen form. This form of trade requires that the gland remain frozen at all stages, from hunter to end-consumer.

Muscone, the proportion by weight of which is 0.5-2% of the whole dried gland, and muscopyridine constitute the main components of the musk scent. Similar macrocyclic alcohols and ketones are found in the glandular secretions of the Muskrat and various civets. Musk also contains fats, waxes, cholesterols and resins (Mukerji, 1953). One French perfumery found the content of muscone in musk samples in Kathmandu to be three times higher than that in samples of musk in France, because it was adulterated before it came to France (Green and Taylor, 1986).

Although traditionally musk has been obtained by killing the deer and removing the entire gland (pod), in musk deer farms in China methods have been under development since 1958 to remove musk without killing the animals (Zhang, 1983). According to Green (1989), it is also possible to harvest musk from wild musk deer without killing them (see **Musk deer farming and management of musk deer in zoos**).

OTHER "MUSK" SPECIES IN THE ANIMAL AND PLANT KINGDOMS

Some other animal and plant species are associated with the musk odour. They produce similar aromas or substances which, while smelling of, or similar to, musk have a different chemical structure. Yet other species have nothing in common with the chemical substance of musk nor with the musk odour, but are popularly referred to in this context. The following list is not exhaustive.

The **Muskrat *Ondatra zibethica*** was originally indigenous to North America and found in wetlands, rivers and lakes. Through introduction and escapes since the early twentieth century, feral populations became established in a broad belt across the whole of northern Eurasia. The musk scent in the Muskrat is produced in two small glands between the anus and the genitals and is exuded when the animal is stimulated. This musk is not suitable for the manufacture of essences in perfume production.

The **African Civet *Civettictis civetta***, occurring in sub-Saharan Africa, and other African and Asian civet species are a valuable source of a musk-like substance called "civet" (Schreiber *et al.*,1989). This yellowish secretion has the consistency of butter and is a product from scent glands located near the civet's

anus. Civet mainly comes from Ethiopian civet farms and is used as a raw substance in the perfume industry, particularly in France. In 1988, the value of civet was US$0.45/g.

The **Russian Desman** ***Desmana moschata*** produces "musk" from glands at the base of its tail, which lends the animal a musky odour. The species is distributed in Russia in the Caspian and Black Sea regions. In particular during the last century, the Russian Desman was hunted for its musk, for use in the perfume industry (Fons, 1988). The species became so threatened that by 1978 it was placed on the Red List in Russia and thus became protected.

Musk Oxen ***Ovibos moschatus*** occur naturally in Greenland and north of the Arctic Circle in Canada and have been introduced into Norway, Sweden, Russia and the USA (Alaska). Musk oxen have pre-orbital glands rather than musk glands. They do not, however, have a strong musky odour. The origin of the vernacular name remains unclear. It is assumed to stem from the French translation of the Ojibwa Indian word for "wet tundra" or "swamp", where musk oxen were observed. A second possible explanation is that the discoverers of musk oxen mistakenly believed that they had musk glands (David R. Klein, pers. comm., March 1998).

The **Suni** ***Neotragus moschatus*** is an antelope inhabiting dry scrub land in south-east Africa (Stuart's and Stuart's, 1988). The Suni emits a strong musky odour from its pre-orbital glands (Walther, 1988).

The **Musk Mallow** ***Hibiscus abelmoschus*** Malvaceae produces seeds that smell of musk and from which oil is obtained (Falbe and Regitz, 1995). Musk Mallow occurs in India and was introduced to the tropics. It is also used as a musk scent in the perfume industry. One millilitre of essential oil from Musk Mallow seeds sells for about US$22, the oils being extracted by means of a distillation process.

The **Musk Rose** ***Rosa moschata*** Rosaceae occurs in the Himalayas, Iran, the countries of the Mediterranean and Ethiopia. It has been introduced into South America as a neophyte and is known there as "Rosa mosqueta". The plant smells musk-like.

The **Musk Milfoil** ***Achillea erba-rotta*** subsp. ***moschata*** Asteraceae occurs in the central and southern Alps. It gives off a remarkable aromatic and spicy scent which has undoubtedly contributed to its name (Wendelberger, 1976). Extracts of Musk Milfoil are used in homeopathy. The species is protected in Germany under the Federal Species-Protection Regulation.

THE GLOBAL TRADE IN MUSK

As explained in **Methodology**, inconsistencies and lacuna are inherent in the CITES annual reports on which the WCMC data are based. In considering the trade information presented in this chapter, this should be borne in mind. In particular, the records for 1995 and 1996 were found to be incomplete (M.Gulliver, pers. comm., June 1998). For example, by June 1998, Japan, Russia and Hong Kong had not submitted their annual reports of 1996 to the CITES Secretariat, while for 1995 data from Hong Kong are missing. Furthermore, although all musk deer species *Moschus* spp. have been listed in the CITES Appendices since 1979, some musk deer range States (North Korea, Bhutan and possibly Kyrgyzstan), and some non-range traders (Yugoslavia and Taiwan) are not Parties to CITES (**Tables 3** and **4**). These non-Parties do not report trade in musk deer specimens to the CITES Secretariat and information relating to such trade has therefore been derived from the CITES annual reports of their trading partners. Yet other countries, which are Parties to CITES, have held so-called "reservations" for trade in musk deer, with the effect that they were exempt from CITES requirements with respect to such trade. From 1993 to 1996, South Korea maintained a CITES reservation for trade in musk deer species listed in Appendix II and, as a consequence, traded in musk like a non-Party State. Likewise, Japan held a reservation on musk deer

included in Appendix I from 1980 to 1989, and a reservation on Appendix-II musk deer species from 1983 to 1989.

The categories of musk deer specimens in trade, as used in CITES tabulations, are shown in **Table 2**, as well as the number of records of trade in each, 1978-96.

Table 2

Number of records of musk deer specimens in CITES tabulations, and descriptions of the specimens in trade (1978-96)

Abbreviation	Musk deer specimen in trade	Number of records	Proportion (%)
BOC	Bone carvings	1	0.16
BOD	Bodies	14	2.29
BON	Bones	2	0.33
BOP	Body parts	1	0.16
BPR	Bone products	1	0.16
DER	Derivatives	356	58.17
FOO	Feet	1	0.16
HPR	Horn products	1	0.16
LIV	Live animals	24	3.92
MUS	Musk	173	28.27
OIL	Oil	2	0.33
SKI	Skins	2	0.33
SKP	Skin parts	10	1.63
SKU	Skulls	3	0.49
SPE	Scientific specimens	12	1.96
TRO	Trophies	9	1.47
	Total	**612**	**100.00**

Source: WCMC, January 1998.

Table 2 indicates that international trade in musk deer products appears to have been chiefly in derivatives and raw musk for the period 1978-96. Most derivatives are medicines containing musk. The great majority of trade in musk derivatives is dominated by exports from China and imports by some East and Southeast Asian countries (for example, Japan, Hong Kong and Singapore) and by certain Western countries (USA, New Zealand, Australia). It is important to recognise, when considering the trade in musk derivatives reported by CITES Parties, that permits would not be issued for all products traded internationally that could contain musk: examples of products exempt from permitting requirements include perfume phials and traditional East Asian medicines. Hong Kong, for instance, does not control international trade in patent medicines containing musk (J. Mills, pers. comm., October 1998). This observation notwithstanding, the CITES records indicate that 35 countries exported or re-exported specimens of musk or other musk deer products between 1978 and 1996 (**Table 3**).

Exports of musk deer specimens

Nine of the countries listed in **Table 3** were musk deer range States, while 26 were re-exporting countries (a distinction will be made below between exporting and re-exporting only when it is explicitly mentioned). Seven countries reportedly exported raw musk; eleven reportedly re-exported raw musk. Although China hardly features in the raw musk trade (see **Trade in raw musk only**), it is one of the major exporters of musk deer derivatives. Very little is known about the trade and consumption of musk inside China. According to Wang *et al*. (1993) the quantity of musk that was annually traded in China in the early 1980s ranged from 2000 to 2500 kg. According to Sheng and Ohtaishi (1993), some 500 000 musk deer were killed every year in China in the 1960s. This over-exploitation of Chinese musk deer populations led to declines from approximately three million musk deer in the 1950s to about one million animals in the 1970s. Much of this musk is used in the production of medicinal derivatives and then traded worldwide.

Table 3

Table to show the 35 countries that exported or re-exported musk deer products, including musk, 1978-96, according to CITES annual reports

Country	Year of CITES membership	Musk deer range State	Export of raw musk	Re-export of raw musk
Australia	1976			
Austria	1982			
Cambodia	-			xxx
Canada	1975			
Chad	1989			
China	1981	xxx	xxx	
East Germany	1976			
Finland	1976			
France	1978			xxx
Germany	1976			xxx
Hong Kong	1976			xxx
India	1976	xxx	xxx	
Indonesia	1978			
Japan	1980 R! - 7/83-4/89			xxx
Kenya	1978			
Kyrgyzstan	-	xxx	xxx	
Macao	1980			xxx
Malaysia	1977			
Mongolia	1996	xxx	xxx	
Nepal	1975	xxx	xxx	
North Korea	-	xxx		
Philippines	1981			
Poland	1989			
South Korea	1993 R! - 10/93-10/96			xxx
Russia	1992	xxx	xxx	
Senegal	1977			xxx
Singapore	1986			xxx
Soviet Union	1976	xxx	xxx	
Switzerland	1974			xxx
Taiwan	-			
Thailand	1983			
UK	1976			
USA	1974			
Uzbekistan	1997			xxx
Vietnam	1994	xxx		

R!: CITES reservation clause in respect of the listing of musk deer.

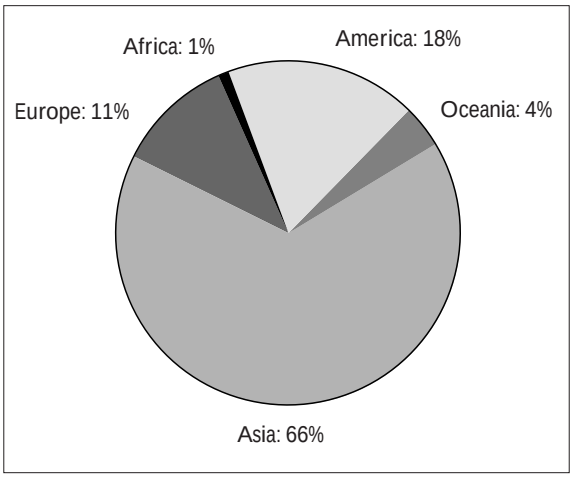
Source: CITES annual reports. WCMC, January 1998.

Imports of musk deer specimens

In terms of imports, 42 countries were recorded as importing musk products, according to CITES annual reports, 1978-96 (**Table 4**). Thirteen countries reportedly imported raw musk; seven reportedly re-exported raw musk.

Figure 2

Percentage of international trade in musk deer products, including musk, attributable to different continents, 1978-96, according to CITES annual report data



Source: WCMC, January 1998.

For the period under review, Asian countries accounted for two-thirds of all records referring to international transactions of musk deer products, as reported by CITES Parties **(Figure 2**); American countries, including USA and Canada, accounted for about one-fifth of the same; European countries, including the Soviet Union and Russia, for 11%; and Oceania and Africa played minor roles.

The products in trade (e.g. trophies, live animals) are numerically quantified, but some of the transactions reported by CITES Parties do not allow calculation of the amount of musk, nor the number of musk deer in trade (Anon., 1993). Musk oil, for instance, is specified in terms of the number of bottles traded and derivatives are quantified by number of crates, boxes or bags. For the remainder of this chapter (**The global trade in musk**), therefore, only trade of *raw* musk is examined in detail, since it is possible to quantify the amounts of this category in trade.

Trade in raw musk only

As it is possible to quantify the amounts of raw musk in trade, it follows that it is also possible to estimate the numbers of musk deer implicated. For this study, such estimates have been made using the following average values: weight of musk in one musk gland: 25 g (Green, 1989); number of musk deer killed: three to five animals taken to obtain one male musk deer with a sufficiently large musk gland (Green, 1986; Jackson, 1979 and Prikhod'ko, 1997). The quantity of raw musk in trade is expressed in kilogrammes (kg) or grammes (g). Of the 173 available records of musk traded (see **Table 2**), only six lacked reference to the weight in trade and these transactions are not included in the analysis that follows.

According to CITES records, there were seven musk deer range States that exported raw musk between 1978 and 1996 (**Table 3**). The quantities of raw musk reported in trade differed widely between exporting countries and their corresponding importing countries (**Table 5**). As pointed out in **Methodology**, this may be a function of varying reporting methods; of different levels of detail in the reports; of the timing of the submission of the annual reports; of clerical errors; a question of whether or not the trading State was a CITES Party; or a combination of these factors.

Table 4

Table to show the 42 countries that imported musk deer products, including musk, 1978-96, according to CITES annual reports

Country	Year of CITES membership	Musk deer range State	Import of raw musk	Re-export of raw musk
Australia	1976			
Belgium	1983			
Bulgaria	1991			
Canada	1975		xxx	
China	1981	xxx	xxx	
Denmark	1977			
East Germany	1976			
Finland	1976			
France	1978		xxx	xxx
Gabon	1989			
Germany	1976		xxx	xxx
Ghana	1975			
Honduras	1985			
Hong Kong	1976		xxx	xxx
India	1976	xxx		
Indonesia	1978			
Italy	1979			
Japan	1980 R! 7/83-4/89		xxx	xxx
Macao	1980			
Malaysia	1977			
Mauritius	1975			
Netherlands	1984			
New Zealand	1989		xxx	
North Korea	-	xxx	xxx	
Norway	1976			
Philippines	1981			
Poland	1989			
Portugal	1980			
South Korea	1993 R! 10/93-10/96		xxx	xxx
Romania	1994			
Senegal	1977			
Singapore	1986		xxx	xxx
Soviet Union	1976	xxx		
Spain	1986			
Switzerland	1974		xxx	xxx
Taiwan	-		xxx	
Thailand	1983			
Togo	1978			
UAE	1990			
UK	1976			
USA	1974		xxx	
Yugoslavia	-			

R!: CITES reservation clause in respect of the listing of musk deer.

Source: CITES annual reports. WCMC, January 1998.

Table 5

Quantities of raw musk reported in trade from range States (and Uzbekistan) and the number of male musk deer and of musk deer in total estimated to have been killed to supply this trade, 1978-96

Country of export	Quantity (kg) as reported by country of export	Quantity (kg) as reported by country of import	Number of male musk deer involved in trade*		Total number of musk deer involved in trade*	
			EX quantity	IM quantity	EX quantity	IM quantity
Soviet Union	283	364	11 320	14 560	33 960-56 600	43 680-72 800
Russia	172.6	112.9	6904	4516	20 712-34 520	13 548-22 580
Kyrgyzstan**		125		5000		15 000-25 000
Uzbekistan***		126		5040		15 120-25 200
Mongolia		350		14 000		42 000-70 000
China	1	0.5	40	20	120-200	60-100
Nepal		20.1		804		2412-4020
India		0.1		4		12-20

Notes: EX = reported by countries of export, IM = reported by countries of import.

* Average weight of musk in one musk gland: 25g. To get one male musk deer with a sufficiently large musk gland, at least three to five musk deer have to be captured (Green, 1986; Jackson, 1979 and Prikhod'ko, 1997).

** Musk deer may occur in Kyrgyzstan in very low numbers, and it would appear unlikely that 125 kg of musk could be harvested in the country. The amounts of musk that were reportedly exported from the country may therefore actually have originated elsewhere - in all likelihood in the Russian Federation.

*** Uzbekistan is not a range State of musk deer, and is not a valid "Country of Origin" for raw musk, although it is indicated as such in the CITES tabulations that were analysed. South Korea, a destination country, recorded imports "originating" from this country in 1994 and in 1995, but these records must refer to re-exports of musk by Uzbekistan that originated from elsewhere - most likely the Russian Federation.

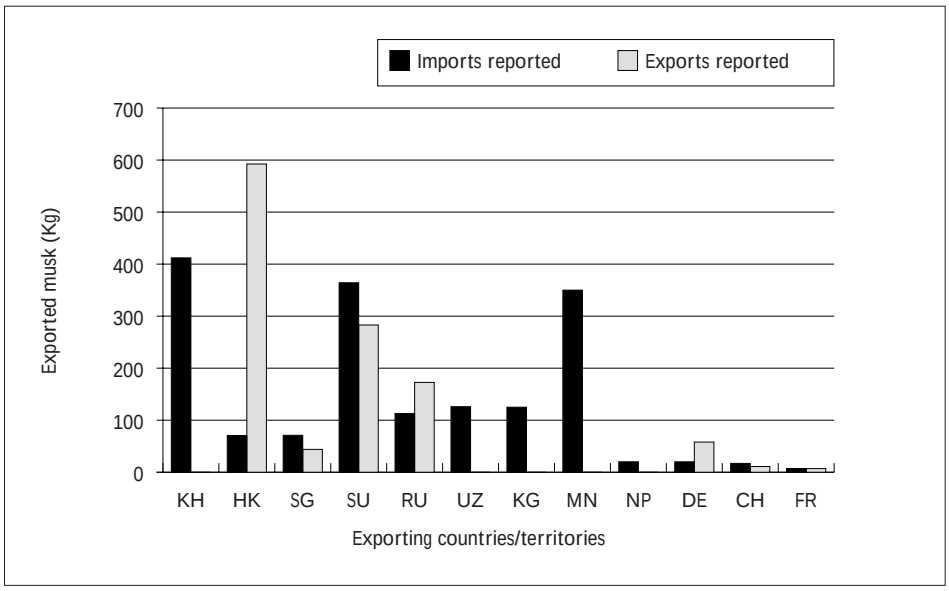
Source: WCMC, January 1998.

The Soviet Union (from 1978 to 1992) and the CIS republics (Commonwealth of Independent States) of Russia, Kyrgyzstan and Uzbekistan (from 1992 to 1996) were reportedly the main exporting countries of raw musk. Uzbekistan is not a range State of musk deer. According to the records of destination countries, the CIS countries exported 363.9 kg of raw musk, 1992-96, which is as much as the total volume that the Soviet Union exported during the 14 preceding years (364 kg) (see **Table 5**). To obtain 363.9 kg of raw musk, an estimated 40 000 to 75 000 musk deer need to be hunted and killed. Exports from Mongolia, 1994-95, recorded by importing countries, totalled 350 kg, equating to a similar number of musk deer.

Between 1978 and 1996, countries and territories exporting or re-exporting quantities of raw musk in excess of 100 kg were Cambodia, Hong Kong, the Soviet Union, Russia, Uzbekistan, Kyrgyzstan and Mongolia (see **Figure 3** and **Table 6**). CITES records indicate that between 1978 and 1996, Cambodia and Hong Kong were the main re-exporters in the international raw musk trade, while Mongolia, the Soviet Union and the Republics of the CIS were important primary exporters and source countries for raw musk (see **Table 6**).

Figure 3

The 12 major exporting and re-exporting countries and territories and the amounts of raw musk exported by each, 1978-96, as reported by the exporting countries and territories themselves and by destination countries



Notes: CH: Switzerland; DE: Germany; FR: France; HK: Hong Kong; KG: Kyrgyzstan; KH: Cambodia; MN: Mongolia; NP: Nepal; RU: Russia; SG: Singapore; SU: Soviet Union; UZ: Uzbekistan.

Source: WCMC, January 1998.

Detailed statistics for each of the exporting or re-exporting countries that traded more than 100 kg of raw musk from 1978 to 1996 are presented in **Appendix 1**.

From 1978 to 1996, the major importing countries of raw musk were South Korea, Hong Kong, France, Singapore, Japan and Canada, each with a total import volume of more than 100 kg (see **Tables 6** and **7** and **Figure 4**). The origin of the musk that Cambodia re-exported was not recorded and remains unknown.

Table 6

Seven countries and territories that exported or re-exported more than 100 kg of musk, 1978-96, and the corresponding importers

Country/ territory of export /re-export	Country/ territory of import, as reported by country/territory of export	Quantity (kg), as reported by country/ territory of export	Country/territory of import, as reported by country/territory of import	Quantity (kg), as reported by country/ territory of import
Hong Kong	Japan	260	France	39.62
	France	139	Japan	14
	Canada	123	Switzerland	10
	South Korea	23	Singapore	6
	Switzerland	17	South Korea	1
	Singapore	10.5		
	China	10		
	USA	10		
	North Korea	1		
	Taiwan	0.38		
Cambodia			South Korea	412
Mongolia			South Korea	350
Soviet Union	Hong Kong	171	Hong Kong	332.14
	Singapore	61	France	22.02
	Japan	36	Singapore	10
	France	15		
Russia	Germany	58.4	Germany	58.682
	Hong Kong	48.8	Hong Kong	30.2
	Switzerland	39.3	Singapore	17
	Singapore	19	South Korea	5
	South Korea	6.25	Switzerland	2
	China	1		
Uzebekistan*			South Korea	126
Kyrgyzstan**			South Korea	125

Notes:

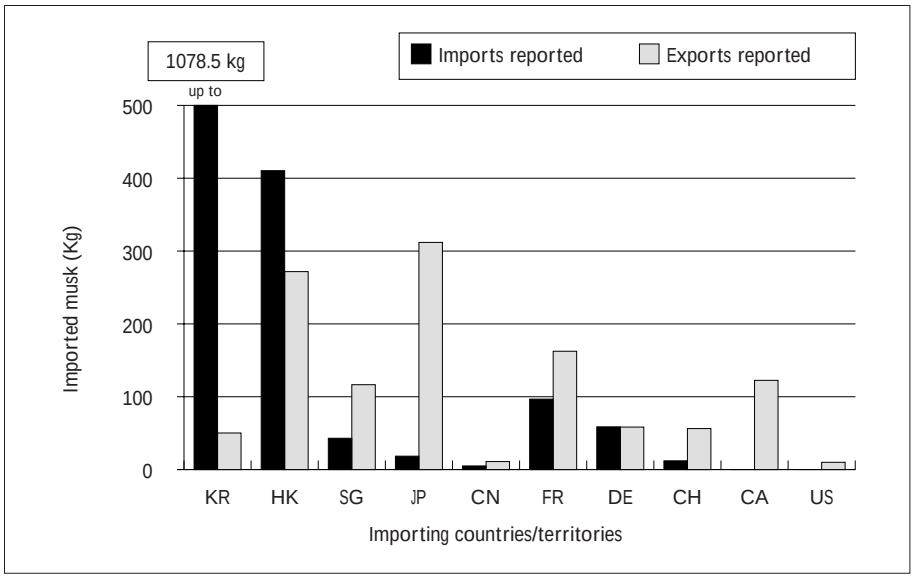
* Uzbekistan is not a range State of musk deer, and is not a valid "Country of Origin" for raw musk, although that it is indicated as such in the CITES tabulations that were analysed. South Korea, a destination country, recorded imports "originating" from this country in 1994 and in 1995, but these must refer to re-exports of musk by Uzbekistan that originated from elsewhere - most probably in the Russian Federation.

** Musk deer may occur in Kyrgyzstan in very low numbers, and it would appear unlikely that 125 kg of musk could be harvested in the country. The amounts of musk that were reportedly exported from the country may therefore actually have originated elsewhere - in all likelihood in the Russian Federation.

Source: WCMC, January 1998.

Figure 4

The 10 major destination countries and territories for raw musk and the amounts imported by each, 1978-96, as reported by the destination countries and territories themselves and by exporting countries



Notes: CA: Canada; CH: Switzerland; CN: China; DE: Germany; FR: France; HK: Hong Kong; JP: Japan; KR: South Korea; SG: Singapore; US: USA.

Source: WCMC, January 1998.

Of the major importers, only Hong Kong, Singapore and Cambodia re-exported significant quantities of raw musk from 1978 to 1996. South Korea, France and Japan appear to have consumed most of their imported musk, or to have manufactured derivatives for re-export (**Table 7**). The quantities of derivatives exported from South Korea and Japan are far lower than the amounts exported from China. South Korea reported obtaining the musk it imported mainly from Cambodia, Mongolia, Kyrgyzstan and Uzbekistan (a non-range State).

Detailed statistics of each of the countries that imported more than 100 kg of musk, 1978-96, are presented in **Appendix 2**.

Data other than those in CITES annual reports indicate that in the 1970s and early 1980s, Japan was the largest importer of musk, accounting for 85% of global trade (Green, 1986). Then, as now, Hong Kong was the international centre of raw musk re-exports. From 1983 to 1989, Japan maintained a reservation on musk deer that were listed in Appendix II of CITES and consequently did not report any trade data to the CITES Secretariat during this period. However, about 275 kg, with a market value of about US$4.2 million, were imported annually into Japan during the period 1974-83, according to Green (1986). Official Japanese trade figures indicated that between 215 kg and 300 kg of raw musk were imported to Japan from China annually from 1981 to 1985 (Green, 1989). Before the 1970s, Japan imported much raw musk from India and Nepal (Green, 1989).

Regional project studies by TRAFFIC are expected to yield further information about Asia's role in the musk trade.

Table 7

Six destination countries and territories that each imported more than 100 kg of raw musk, 1978-96, and the associated exporting countries

Country/ territory of import	Country/ territory of export, as reported by country/territory of import	Quantity (kg), as reported by country/ territory of import	Country/territory of export, as reported by country/territory of export	Quantity (kg), as reported by country/ territory of export
Hong Kong	Soviet Union	332.14	Soviet Union	171
	Russia	30.2	Russia	48.78
	Singapore	13	Germany	32
	Germany	10	Singapore	13
	France	7	France	7
	Japan	7		
Singapore	Russia	17	Soviet Union	61
	Germany	10	Germany	26
	Soviet Union	10	Russia	18.991
	Hong Kong	6	Hong Kong	10.537
South Korea	Cambodia	412	Hong Kong	23
	Mongolia	350	Singapore	15
	Uzbekistan	126	Russia	6.245
	Kyrgyzstan	125	Switzerland	5
	Singapore	54		
	Switzerland	5		
	Russia	5		
	Hong Kong	1		
	China	0.5		
Japan	Hong Kong	14	Hong Kong	259.5
	South Korea	2.25	Soviet Union	36
	Singapore	2	Singapore	13
	France	0.17	South Korea	2.387
			China	1
France	Hong Kong	39.62	Hong Kong	138.52
	Soviet Union	22.02	Soviet Union	15.02
	Nepal	20.1	Switzerland	6
	Switzerland	12	Singapore	2.925
	Singapore	2		
	Senegal	1		
Canada			Hong Kong	122.518

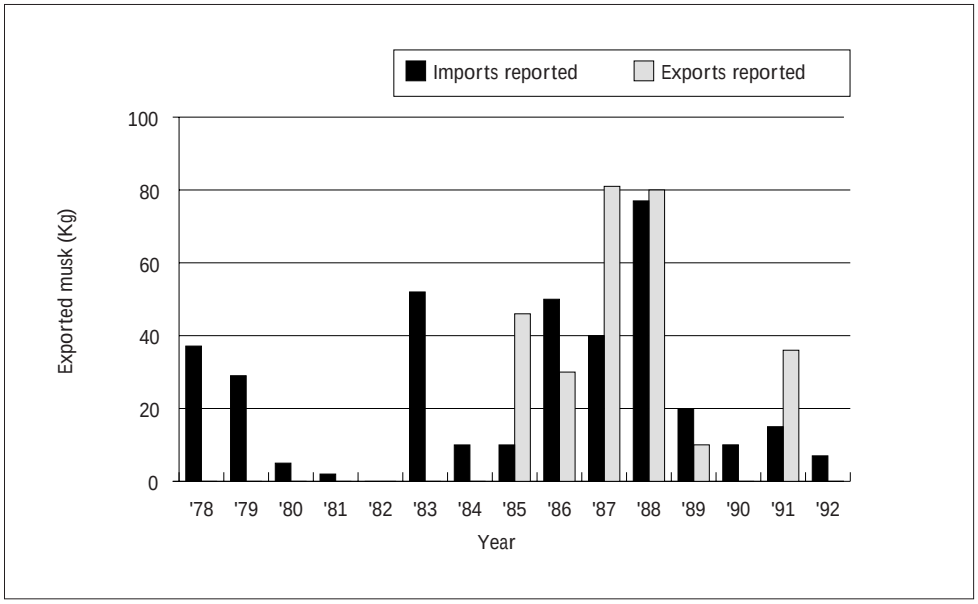
Source: WCMC, January 1998.

Trade in and from the Soviet Union and the CIS republics

As stated, the Soviet Union and its successors Russia, Kyrgyzstan and Uzbekistan emerge from the data compiled by WCMC as some of the main exporting countries for raw musk. According to the data, the Soviet Union exported 364.16 kg of raw musk, based on reports from countries of import, and 283.02 kg, according to reports from the Soviet Union itself, in the period 1978-92 (**Figure 5**). The largest quantities were exported in the years 1985-88.

Figure 5

Quantities of raw musk exported from the Soviet Union in the period 1978-92, as reported by the Soviet Union itself and by importing countries and territories



Source: WCMC, January 1998.

The Soviet Union's main partners in the musk trade, 1978-92, were Hong Kong, Singapore, Japan and France (see **Table 6**).

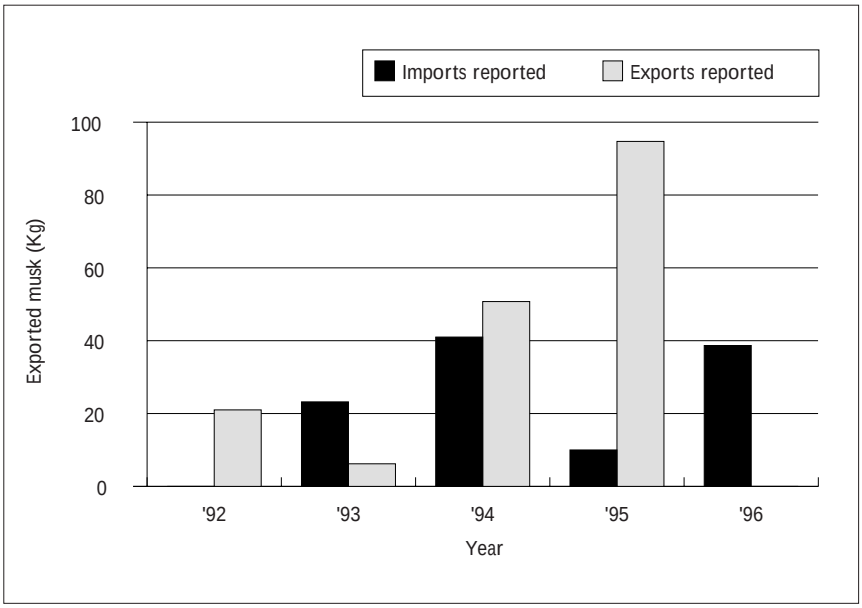
Following the dissolution of the Soviet Union, Russia, Kyrgyzstan and Uzbekistan were the only CIS States that were reported to be trading in musk. According to WCMC data, Russia exported 112.88 kg of raw musk, according to the countries of import, and 172.67 kg, according to Russia itself, during the period 1992-96 (see **Figure 6**). The rise in exports during 1995 is significant.

Russia's musk trading partners from 1992 to 1996 were Hong Kong, Singapore, South Korea, China, Germany and Switzerland (see **Table 6**). Germany and Switzerland have only been involved in the world trade in musk since the early 1990s, but became leaders in the trade with Russia after just a few years.

In 1994, Kyrgyzstan and Uzbekistan exported 125 kg and 126 kg of raw musk, respectively, as reported by the sole country of import, South Korea (see **Table 6**).

Figure 6

Quantities of raw musk exported from Russia in the period 1992-96, as reported by Russia itself and by importing countries and territories



Source: WCMC, January 1998.

Russia's export quotas for musk

Russia first informed the CITES Secretariat of its annual export quotas for musk in 1995. These quotas are communicated to the Parties by the Secretariat in the form of Notifications, according to which Russia's export quotas have included the following:

1995: 70 kg musk, of which 50 kg was to be from 6000 musk deer in 1995 and 20 kg from previous years (*Notification No. 874*)
1996: 40 kg musk (*Notification No. 916*)
1997: 40 kg musk (*Notification No. 994)*
1998: 35 kg musk (*Notification No. 1998/07*)

Total exports from Russia in 1996 did not exceed the annual export quota according to the available CITES trade data (see **Figure 6**). In 1995, however, Russia's own export data suggest that the exported volume exceeded the quota for that year by about 25 kg.

It is possible that the gradually falling export quotas reflect the fact that Siberian Musk Deer populations in the territory of present-day Russia could have declined by up to 50-60% since 1990-93, to current levels of between 53 000 and 60 000 individuals (Prikhod'ko, 1997) (see ***Population in the Soviet Union and Russia***).

Trade to and from Germany, France and Switzerland

Germany, France and Switzerland are the only countries in Europe which report importing musk. Data on France's trade in musk have been available since 1980. Switzerland and Germany first appeared in CITES

trade tabulations in 1989 and 1994, respectively. The predominant share of musk imported into Germany, Switzerland and France came from the Soviet Union and later from Russia (see **Table 8**).

Table 8

Musk imported by Germany, France and Switzerland from 1980-96

Period	Country of import	Country of export, as reported by country of import	Country of origin, as reported by country of import	Quantity (kg), as reported by country of import	Country of export, as reported by country/ territory of export	Country of origin, as reported by country/ territory of export	Quantity (kg) as reported by country/ territory of export
1994-1996	**Germany**	Russia	RU	58.682	Russia	RU	58.36
1980-1995	**France**	Hong Kong	SU/RU/?	39.62	Hong Kong	SU/RU/?	138.52
		Soviet Union	SU	22.01	Soviet Union	SU	15.02
		Nepal	Nepal App. I	20.1	Switzerland	SU	6
		Switzerland	SU/RU	12	Singapore	SU	2.925
		Singapore	SU	2			
		Senegal	?	1			
1989-1995	**Switzerland**	Hong Kong	SU/RU	10	Russia	RU	39.29
		Russia	RU	2	Hong Kong	SU/RU	17
		France	SU	0.005	France	SU	0.005

Notes: SU = Soviet Union; RU = Russia; ? = no data; App. I = CITES Appendix I species. Number of exports reported and imports reported differ owing to different reporting methods to WCMC.

Source: WCMC, January 1998.

According to its own import reports, France received some 10 kg of raw musk annually, on average, from the mid-1980s to the mid-1990s (see **Figure 7**). Germany imported 10 kg in 1994 and 1995, each, and in 1996 nearly 40 kg. In the 1990s, Switzerland imported a total of about 12 kg over three years.

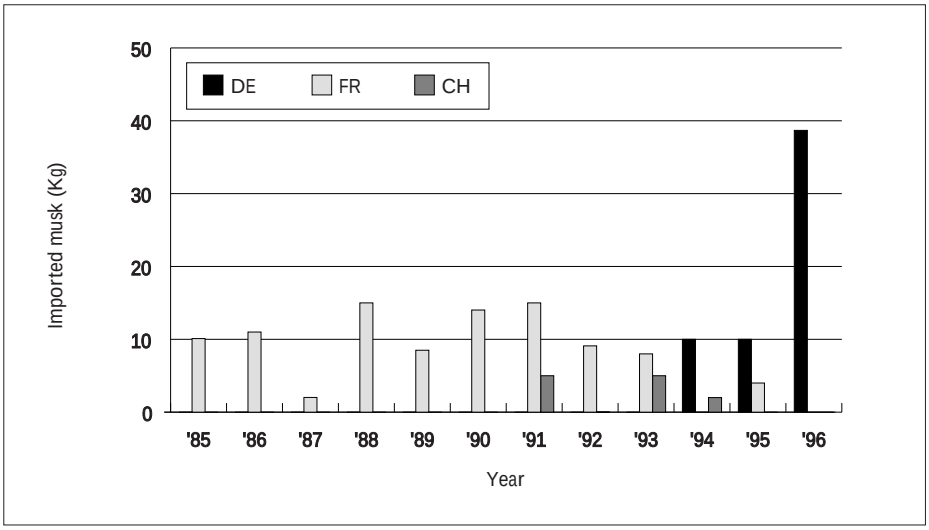
According to CITES reports from the countries of export, France and Switzerland imported substantially more musk over the same period than they themselves declared as imported (see **Figure 8**). Records of exporters to Germany, on the other hand, more or less match the volumes Germany's own import records declare for the same period.

The competent CITES Management Authorities (MAs) in Germany (*Bundesamt für Naturschutz*, Bonn), Switzerland (*Office Vétérinaire Fédéral*, Bern) and France (*Ministère du Territoire et de l'Environnement, Direction de la Nature et des Paysages*, Paris), confirmed that the trade records that were communicated to the CITES Secretariat for compilation by WCMC represent actual levels of trade. (Customs check the shipments upon import, and note actual volumes in the allotted spaces on the relevant CITES documents for compilation by the MAs).

From 1980 to 1996, Germany imported all its musk directly from Russia, Switzerland obtained its musk from Hong Kong, Russia and France, and France itself imported musk from Hong Kong, the Soviet Union, Nepal, Switzerland, Singapore and Senegal (see **Table 8**). France's imports in 1985 and 1986 from Nepal were from Appendix I-listed populations of musk deer.

Figure 7

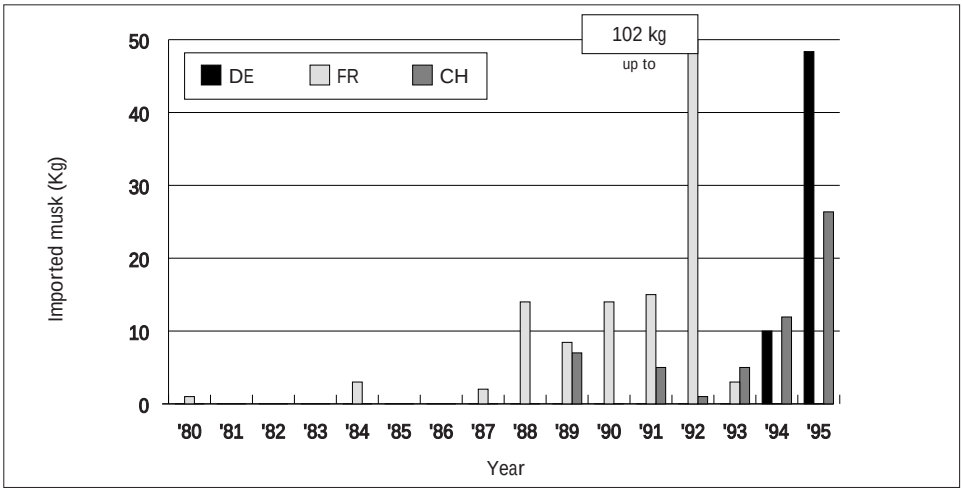
Imports of raw musk by Germany, France and Switzerland from 1985-96, as reported by these countries



Source: WCMC, January 1998.

Figure 8

Imports of raw musk to Germany, France and Switzerland from 1980-95, as reported by exporting countries and territories



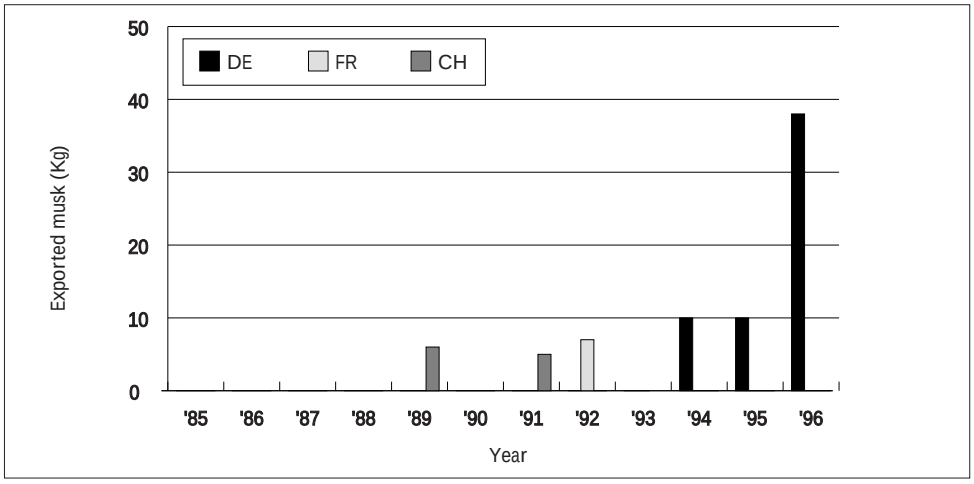
Source: WCMC, January 1998.

Switzerland, and in particular Germany, re-export significant quantities of raw musk (see **Figures 9** and **10**). For example, Switzerland re-exported a total of 11 kg to France and South Korea between 1989 and 1994 (see **Table 9**). German re-exports of raw musk included 58 kg to Hong Kong and Singapore during the period 1994-96. This means that Switzerland re-exported 93%, and Germany 99%, of all the musk that they imported (see **Figure 11**). The import records of France and South Korea, by contrast, refer to 17 kg of musk imported from Switzerland during the same period (see **Table 9**), while import figures from Hong

Kong and Singapore record receiving only 20 kg from Germany, 1994-96, and not 58 kg. Contacts with relevant CITES Management Authorities and musk traders in Germany and Switzerland confirm that the data from the countries of re-export, that is Germany and Switzerland, seem the most reliable in these cases.

Figure 9

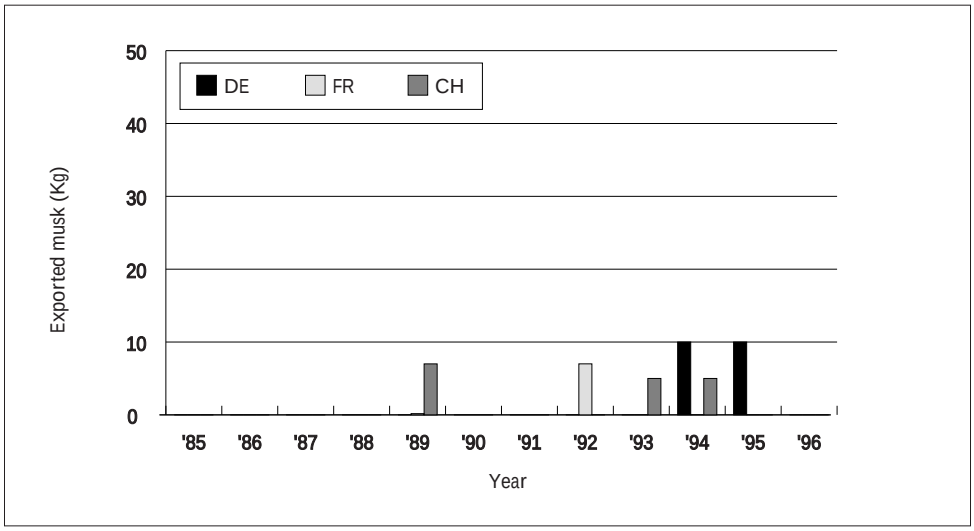
Exports of raw musk by Germany, France and Switzerland, 1985-96, as reported by the countries themselves



Source: WCMC, January 1998.

Figure 10

Exports of raw musk by Germany, France and Switzerland, 1985-96, as reported by countries and territories of import



Source: WCMC, January 1998.

The role of Germany in the international musk trade is remarkable. In only four years following the break-up of the Soviet Union (1992-96), Germany acquired 8% of the global trade in musk from 1992-96, from all range State sources (according to import records) and 34% (according to exporters' records).

Table 9

Musk exported from Germany, France and Switzerland, 1985-96

Period	Country of export	Country/ teritory of import, as reported by countries of export	Country of origin, as reported by countries of export	Quantity (kg), as reported by countries of export	Country/ territory of import, as reported by countries/ territories of import	Country of origin, as reported by countries of import	Quantity (kg) as reported by countries/ territories of import
1994-96	**Germany**	Hong Kong	RU	32	Hong Kong	RU	10
		Singapore	RU	26	Singapore	RU	10
1985-92	**France**	Hong Kong	SU	7	Hong Kong	SU	7
		Switzerland	SU	0.005	Switzerland	SU	0.005
					Japan	SU	0.17
1989-94	**Switzerland**	France	SU	6	France	SU/RU	12
		South Korea	RU	5	South Korea	RU	5

Notes: SU = Soviet Union; RU = Russia.

Source: WCMC, January 1998.

France reported exporting about seven kilogrammes of raw musk, 1989-92, an amount corresponding almost exactly to that reported by countries and territories importing from France during the period. This indicates that France re-exported only 7% of the musk it imported (compare **Tables 8** and **9** and see **Figure 11**). The remaining quantity was probably processed by the French perfume industry.

Information from the CITES Management Authorities in Germany, France and Switzerland

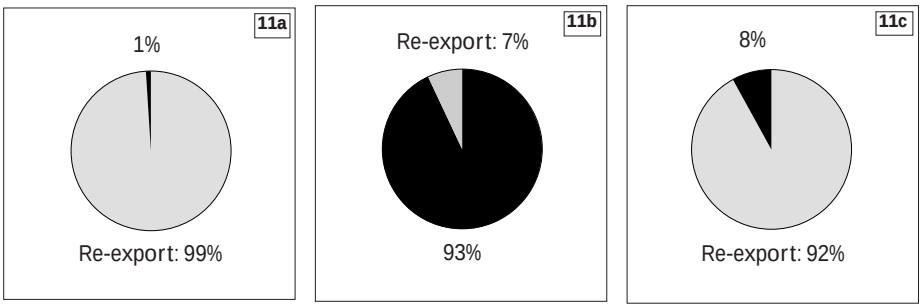
The *Bundesamt für Naturschutz* in Bonn confirmed the trade figures for Germany that are presented in **Tables 8** and **9**. Additionally, it reported, that Germany imported five kilogrammes of raw musk from Russia in 1997.

The *Ministère du Territoire et de l'Environnement, Direction de la Nature et des Paysage* in Paris provided data to TRAFFIC Europe-Germany on France's imports and exports of raw musk for 1996 and 1997. According to the Ministry, France imported 2.04 kg in 1996 and 7.231 kg in 1997. In each case, the musk was imported from Russia and immediately re-exported to Hong Kong.

The *Office Vétérinaire Fédéral* in Bern also confirmed the quantities declared imported and exported by Switzerland, as presented in **Tables 8** and **9**. According to the *Office Vétérinaire Fédéral*, Switzerland re-exported an additional five kilogrammes of musk to France in 1993. A record of this transaction appears in WCMC's CITES tabulations as an import by France, but not as an export from Switzerland. Switzerland thus appears to have exported a total of 16 kg of musk in 1989-93, although its own import figures suggest that it received only 12.005 kg during the same period. No imports are recorded as having taken place in 1995 and 1996, and no re-exports in 1994-96.

Figures 11 a), b) and c)

Proportion of imported musk re-exported by a) Germany, b) France and c) Switzerland



Source: WCMC, January 1998.

In Switzerland, as in European Union (EU) Member States and in a few other countries, CITES-implementing legislation requires that the Management Authority grant an import permit before particular CITES Appendix II-listed species, or derivatives from them, such as musk, may be imported into the country (P. Dollinger, pers. comm., March 1998).

Information from musk re-exporting companies in Germany and Switzerland

Since 1995, the export quotas for musk set by Russia have had an effect on the musk trade of middlemen (companies importing and re-exporting musk) from Germany and Switzerland. They obtain the musk directly from hunting co-operatives in Russia that are allowed to kill only the number of musk deer for which they have been granted hunting licences (middlemen, pers. comm., March 1998).

Some middlemen in Germany and Switzerland believe that there is significant smuggling of musk in Russia: the level cannot be quantified. East Asian black market dealers, in particular, are said to be involved in the smuggling (middlemen, pers. comm., March 1998). In the early 1990s, German middlemen reported that they supplied musk to Hong Kong, Singapore and South Korea, while by the end of the 1990s, the entire supply was sold to South Korea. The Swiss middlemen also reported re-exporting exclusively to East Asia and particularly to South Korea. The demand for musk is said to be larger than the amount legally available and certainly exceeds the supply from Russian export quotas. In recent years, prices of musk have therefore increased by about 35-40%. Musk is currently purchased at about US$12-14/g in Europe and in South Korea. According to traders in Germany and Switzerland, East Asia is solely supplied with whole musk glands (pods).

German and Swiss companies operate in the musk trade as middlemen since this offers greater financial security than functioning as regionally based companies in Russia and trade connections between Russia and Germany have been very good. There are reportedly no contacts between these German and Swiss middlemen, who handle a major part of the European imports and exports of musk, and the companies in the perfume industry in Europe.

German traders claim that the illegal trade in musk in eastern Russia, seemingly controlled by organised groups, is now an extremely dangerous, even life-threatening, activity. Recently, some middlemen in Germany were requested to procure CITES permits to accompany illegally harvested musk, ostensibly for import to East Asia. This clearly suggests an attempt to give the appearance of legality to illegally acquired musk.

Summary of all trade data in raw musk

In reviewing overall global trade in musk, 1978-96, it can be concluded that the Soviet Union, Russia, possibly Kyrgyzstan, and Mongolia were the major countries of origin for raw musk on the international market (**Table 5**). The trend in the trade in raw musk indicates a dramatic increase in the export figures after the break-up of the Soviet Union in 1992 (**Appendix 1**). Uzbekistan was an incorrectly reported source country that probably re-exported Russian musk. The CITES tabulations compiled by WCMC contain references to the export of hundreds of kilogrammes of raw musk from Cambodia, which is also indicated as the country of origin for the export. As in the case of Uzbekistan, this seems highly unlikely because Cambodia is not a range State for musk deer (Wemmer, 1998). China was the major exporter of musk products and derivatives, while Hong Kong, Singapore and Cambodia acted as notable re-export centres for musk. A one-off export of 122 kg of raw musk from Hong Kong in 1985 was not declared by the reported importing country, Canada, and could be an error. The major consumers of raw musk were South Korea, Japan and France. Germany and Switzerland have only been involved in the world trade in musk since the early 1990s, but became leaders in the trade with Russia after just a few years. Nearly all musk that was imported to Germany and Switzerland was re-exported, mainly to East Asia.

Illegal trade in Europe (including Russia)

Russia

Of the 240 kg musk that was reported as officially traded in the Russian part of the Soviet Union and in Russia from 1989 to 1993 (see **Table 1**), 30-40%, or approximately 70-100 kg, was estimated to be from illegal sources (Prikhod'ko, 1997). A survey by TRAFFIC International (1994) of the illegal trade in musk and other natural products in the Russian Far East showed that Vladivostok and Khabarovsk were major centres of legal and illegal trade in the region. Since the early 1990s the trade in musk has become increasingly organised and has, since the mid-1990s, been in the hands of a small number of firms or organisations. Owing to the large proportion of East Asian people in the region and their high level of demand for musk, there is a great deal of trading in musk in this region, both legal and illegal. In the 1996-97 hunting season, 55 kg of musk were traded in the Russian Far East via Khabarovsk, but it was estimated that only about 30% of the trade was conducted legally (TRAFFIC Europe-Russia, *in litt*., 1997). Smuggled musk glands can be hidden with ease and carried over the border to China or shipped to South Korea. The smuggling routes across the Russian-Chinese border have not been identified to date and the risk of interception for the smugglers is very low. The proportion traded to Japan is estimated to be less significant (TRAFFIC International, 1994).

According to TRAFFIC Europe-Russia staff (*in litt*., 1997), the region around Irkutsk also appears to be growing in importance in the musk trade and to be of equal importance to the Russian Far East.

Germany, France, Switzerland, Belgium, UK and the Netherlands

In Germany, information on illegal trade in wildlife and wildlife products, including musk, is centralised at the *Zollkriminalamt* (ZKA) in Cologne and also held by regional Customs investigations offices. According to the ZKA and some Customs investigation officers, there were no records of illegal musk trade nor of musk seizures in Germany between 1993 and 1998.

According to the *Bundesamt für Naturschutz* in Bonn, one seizure of products claiming to contain processed musk was made in 1991 and another in 1992. Both consignments came from China. In 1995, several thousand products which claimed to contain musk were seized. However, the results of laboratory analysis showed no musk ingredients in these products.

The *Ministère du Territoire et de l'Environnement, Direction de la Nature et des Paysages* and the *Direction National du Renseignement et des Enquêtes Douanières* in Paris reported five seizures of musk in France since 1988 (**Table 10**). Three seizures concerned raw musk while the other two were of musk tincture (musk: alcohol dilution ratio approximately 1:30) for the perfume industry. The goods were transported to France, by air or sea, in crates which attracted the attention of Customs authorities because of the high value of the goods and the penetrating musk aroma. Part of the shipments had false tariff codes and CITES permits were lacking.

Table 10

Seizures of illegally traded musk (M) and musk tincture (T) in France

Year	Quantity of musk seized (kg)	Country of origin	Total value of goods in US$	Value of goods per gramme (g) in US$
1988	47.8 (M)	China (probably)	1 092 143	22.85
1990	41.5 (T)	?	75 452	1.82
1990	15.0 (T)	?	48 098	3.21
1992	0.4 (M)	Singapore	7296	18.24
1995	0.1 (M)	Russia	3473.7	34.74

Source: *Direction de la Nature et des Paysages* and the *Direction National du Renseignement et des Enquêtes Douanières*, May 1998.

According to the *Office Vétérinaire Fédéral* in Bern and the Swiss Customs administration, no seizure of musk nor of musk products took place in the period 1985-98 in Switzerland.

In 1995, numerous traditional East Asian medicines claiming to contain musk ingredients were seized in Asian shops, supermarkets and company premises in Belgium by Customs authorities. Several thousand traditional East Asian medicines have also been seized by the police and Customs officers in various cities in the UK since 1994. These products contained musk or claimed to contain it. In the Netherlands, too, TEAM (traditional East Asian medicine) products have been seized by police, in Utrecht, in 1996. Hundreds of these purported to contain musk.

According to CITES annual report data, from 1978-96 there were no musk derivatives recorded in trade to European countries, excepting reports of traded derivatives from China in 1990-92, which were not confirmed by European countries. Therefore, most products which contained musk, or claimed to contain it, which appeared on the market in Europe during 1978-96 were probably illegal.

Prices for musk

Supply and demand usually determine the prices of natural products and the price of musk varies a great deal. Fomenko (*in litt.*, 1997) reported that a hunter in the Russian Far East could earn approximately US$2-3 per gramme of musk (**Table 11**). Dealers at the intermediate level in Russia retailed musk at about US$7-8/g. The price levels in Russia depend upon the time of the year, the hunting season and the region, as well as the level of demand. In remote regions of Russia it is customary to pay for goods in kind, e.g. with sugar, textiles or vodka (A. Vaisman, pers. comm., March 1998).

According to information from middlemen in Germany and Switzerland, musk is traded in Europe and sold to South Korea for around US$12-14/g (pers. comms, March 1998). In recent years, prices rose by more than 30% as a result of increased demand and reduced legal exports from Russia. Customs services

in Russia recorded a price of approximately US$16-22/g in 1997 for a shipment of musk from Russia to Germany (Russian Customs Service Agents, *in litt.*, 1998). Demand appears to continue to rise, but the current financial and economic crisis in East Asia could reduce the future demand for musk.

Table 11

Prices for one gramme of musk at different stages of trade in early 1998

Raw musk purchase source	Price in US$	Price increase per stage
From hunter in Russia	2-3	
From middlemen in Russia	7-8	about 150%
From middlemen in Europe and South Korea	12-14 in 1997, up to 22	about 100% - 200%
For use in the European perfume industry	up to 50	over 200%

Source: TRAFFIC International (1994); Alexander Kulikov, pers. comm., December 1998; middlemen in Germany and Switzerland, pers. comms, March 1998; perfume manufacturers in Germany, pers. comms, April 1998 and Fomenko (*in litt.*, 1997).

Manufacturers and companies in the perfume industry declared that perfume manufacturers buy musk at up to US$50/g (manufacturers and perfume association personnel, pers. comms, 1998).

In the 1970s and 1980s, the market price for musk in China was very low by comparison with the price in other countries (Green, 1989). In 1979, it stood at just US$3.86/g. In countries of the Himalayan region, it reached US$15.38/g at the same time, and Japanese import statistics indicated that the price on the international market was around US$24/g for musk pod and US$45/g for granular musk (i.e. extracted contents of musk pods) (Green, 1989). In India, the price was recently about US$22/g (Asadi, 1996).

THE USES OF MUSK

Use in the perfume and aromatic substance industry

Musk fragrance: historical use

As far back as prehistoric times perfume was probably used predominantly as a sacrificial offering to pay homage to the gods. The very word "perfume", from "*per fumum*", indicates the activity of burning certain drugs and fragrant resins (Pilz, 1997). Musk is known to have been used in medicine and as a fragrance since 3500 BC. The musk scent was thought to have been used in the early civilisations of ancient China and ancient India in ritual purposes (Pilz, 1997). Certainly, the range of fragrances in ancient China extended from the powerful odour of musk to the gentle fragrance of rose water, the former perfume assigned to the sphere of sensual desires, the latter an embodiment of the spiritual ideal. By the eighth century AD, during the Tang dynasty in China, musk had become so fashionable that one minister had the scent applied to the walls of his pavilion (Green and Taylor, 1986). Musk perfume was also known to the Carthaginians and Phoenicians. In the tenth century AD musk was among the five most important components of perfume of the contemporary Arab world. The Arabs brought musk to the Middle East where they mixed the scent with mortar for use in the construction of mosques, for example at Kara Amed and Tabriz, in Iran.

The first mention of musk in Europe is attributed to St. Jerome in the year 390 AD. The first written reference, in which mention is made of boxes for storing musk, dates from 1398 and can today be found in the British Museum in London. The use of musk is also known from the scent jars which, in the

fifteenth century, were used in hospital rooms to combat epidemics like cholera and plague (Pilz, 1997). In Tudor England, musk was added to sweetmeats and medicines in order to drive away melancholy and by the nineteenth century courtesans in Paris carried bags of musk between their breasts in order to conceal the body's natural odour as well as to enhance it (Green and Taylor, 1986). In the Renaissance period, Italy led the way in the manufacture of perfume, but later the main centre of manufacturing shifted to France and, in particular, to the region around Grasse (Müller, 1991). Compared with other places in Europe, the skilled art of perfume manufacturing was highly developed in the south of France, and Grasse, situated close to Marseilles, occupies a location which at that time was favourable for the trade in oriental merchandise such as musk.

Natural musk is prized for the intensity and endurance of its aroma and for its fixative properties. The generally low-strength alcoholic infusions, matured over long periods, produced from dried and pulverised musk glands, lend themselves to the making of perfumes characterised by the industry as having "warmth", "elegance" and "radiance" (Pilz, 1997). In the manufacturing of aromatic substances, musk is employed not only as a perfume but also as a fixative for other fragrances (Perry, 1925, in Green, 1989). It is to these dual properties that musk owes its popularity in perfumes. Its rarity and high price presented an incentive for replacing natural musk with synthetic products long before the conservation of musk deer species became a concern. As early as 1759, nitration experiments with amber oil produced musk-like perfumes. Synthetically manufactured musk compounds since then have succeeded in imitating the characteristics of natural musk more and more closely.

Credit: Drom Fragrances International – Munich, Paris, New York

French glass perfume phial with enclosed cameo - Baccarat, circa 1860

Musk in the present-day perfume industry of Europe

In Europe, there are well over 100 companies that operate in the perfume industry. The market is becoming increasingly international and many companies operate throughout Europe or worldwide. By virtue of long tradition, however, a particularly large number of these firms is based in France. In Grasse alone, there are about 30 French and foreign companies working on the production of aromatic substances (spokesman for perfume-producing company, pers. comm., May 1998). The boundaries between perfume manufacturers working on the composition of perfume constituents and those creating and marketing the end-product are fluid.

Because of the price and chemical structure of natural musk, the substance is used only in perfumes and *eaux de toilette* with alcohol as a solvent, (spokesmen for perfumeries, pers. comm., April 1998). In perfumed products such as cosmetics, personal hygiene preparations, shampoos, detergents, etc., only synthetic musk is used, and never natural musk. Where natural musk is used, the perfume tinctures contain between 0.5% and 5% musk in an alcohol solution, according to information from perfumeries and manufacturers of perfume oils which incorporate the substance (spokesman for perfume-producing company, pers. comm., April 1998). Such tinctures have to mature for a number of months, at least, before they can be mixed in perfumes.

Interviews with both German and French perfumers revealed that only a small number of perfume companies in Europe, primarily in France, work with very old, traditional, recipes which may contain musk, amber and civet.

Information from perfume manufacturers in Germany, France and Switzerland

About 30 companies in **Germany** are involved in the manufacture of perfume oils and scents. Of these, 15 companies were surveyed by TRAFFIC Europe-Germany. Thirteen companies, including the major manufacturers in Germany, indicated that they had used no natural musk, or virtually none, in their products for many years or even decades (personnel of perfume-producing companies, pers. comm., March 1998). At least four of the 13 companies have large production sites outside Germany, e.g. in France and Switzerland, and operate on a worldwide scale, but these four large perfume oil and scent manufacturers reported not to have used any natural musk in their products since at least 1990. Only two companies of the 13 stated that they occasionally use small amounts (a few grammes per year) of natural musk. According to one manufacturer, other medium-sized manufacturing companies in Germany, apart from those surveyed, no longer use natural musk either.

France has the most traditional perfume industry in Europe. There may be more than a hundred perfume houses, large and small, working in this sector, creating all kinds of new and classic fragrances. Assuming that the musk imported to France was used primarily in the European perfume industry, the share of musk used in perfumes by France constituted between 5% and 15% of the unprocessed musk in trade globally from 1978 to 1996.

Information from literature (Green and Taylor, 1986), as well as from personnel in the German perfume industry (pers. comm., April 1998), indicates that only the most traditional and expensive perfume houses may still use amounts of the order of some hundreds of grammes, ranging in some cases to some kilogrammes, of natural musk per year. In July 1998, nine of the biggest and/or notable classic French perfume houses were asked if they still used natural musk in their products. Of the nine, four have so far not responded; one replied that natural musk was not used in their products any more; another failed to respond to the question asked; and a further three responded that they were still using natural musk in a few traditional fragrances, but with a predicted decline in use over the next few years. Nevertheless, the use of natural musk in the French perfume industry is still estimated to amount to some kilogrammes per year (perfume producing company personnel, *in litt.*, 1998). The reasons for the decline in use of natural musk in the French perfume industry are given opposite (see paragraph beginning "The following reasons" ...). Green and Taylor (1986) also reported that natural musk was used by the perfume industry in only a small number of classic and expensive perfumes in France. These included, for example, Chanel's *No 5*, Desprez's *Bal à Versailles*, Guerlain's *L'Heure Bleu*, Rochas's *Madame Rochas* and Shiseido's *Suzuro*.

The perfume oil and scent-manufacturing sector is not as large in **Switzerland** as in neighbouring France and Germany. Two large companies manufacturing perfume oils and scents in Switzerland were asked about the use of natural musk in their products. Both companies reported that they had not used natural musk for at least 10 years (personnel of perfume producing companies, pers. comm., April 1998). One Swiss manufacturer declared that the sector uses less and less natural musk in perfumes.

In February 1998, TRAFFIC Europe-Germany visited *Beauty World* in Frankfurt, Europe's largest trade fair for cosmetics and perfumes, hosting 500 exhibitors from 25 countries. TRAFFIC Europe-Germany interviewed 28 of the 62 exhibitors representing the perfume and cosmetics sectors, including exhibitors from Germany, France and Belgium (and also the USA). Most indicated that they did not know the composition of their products. Only one French exhibitor said that his company's products contained genuine musk. However, he was unable to say whether the musk originated from musk deer or from other plant or animal species.

The following reasons were given to explain why German, French and Swiss perfume and scent manufacturers today no longer use natural musk (personnel of perfume producing companies, pers. comm., April 1998):

- Natural musk is very expensive, costing up to US$50-55/g to perfume companies. Synthetic musk is substantially cheaper. Perfumes would be prohibitively expensive if they contained natural musk and as the struggle for market share is very intense in the perfume and cosmetics sector, companies must offer their products at competitive prices. The price of perfume products in the moderate and inexpensive categories in Germany and other European countries virtually precludes their containing natural musk.

- Some manufacturers mentioned animal welfare and species conservation reasons for refraining from using natural musk. Clients in Europe are increasingly sensitive about these issues and manufacturing companies may often respond to such consumer sensitivities by dropping the use of relevant ingredients, for example, animal substances.

- Natural musk is very difficult to obtain and the supply on the international market is not sufficiently stable for manufacturers of perfume oils and scents.

- Natural musk is of inconsistent quality.

- A further reason mentioned by one manufacturing company for ceasing to use natural musk alluded to related technical difficulties in manufacturing.

Credit: Drom Fragrances International - Munich, Paris, New York

Early eighteenth century south German rock-crystal phial in gilt mounting

Perfume oil and scent manufacturers were asked whether natural musk may again be used by the industry in the future, especially since synthetic musk is associated with health risks (see **Synthetic musk**). All the respondents believed that the use of natural musk in the perfume industry will continue to diminish (personnel of perfume producing companies, pers. comms, April 1998). The development and use of new synthetic musk compounds is regarded as highly promising for the perfume industry and more likely to happen than a renewed increase in the use of natural musk.

Information from European, German and French associations of perfume-manufacturers

Three international associations of scent manufacturing companies of the European perfume and cosmetics industry were consulted about the use of musk. They also reported that natural musk has only restricted use in perfume manufactured in Europe, because of the high price and the difficulty in procuring natural musk (personnel of scent-manufacturing company associations, pers. comm., March 1998). None

of the associations of companies knew of any company still using natural musk today, although this does not rule out the possibility of use of natural musk, not only in France in some classic and expensive perfumes, as mentioned, but also in special perfumes created for private individuals and not otherwise for sale.

In Germany, four national associations of scent manufacturing companies from the perfume and cosmetics industry were consulted. They affirmed that, in Germany, natural musk has practically disappeared in the perfume and scent industry because of the high price, animal welfare and species conservation concerns, and the difficulty in procuring natural musk (personnel of scent-manufacturing company associations, pers. comm., March 1998). None could name a company operating in Germany or in Europe as a whole that still used natural musk. In France, three national associations of scent manufacturing companies in the perfume industry were consulted. According to their information a few kilogrammes of natural musk are indeed still in use, in the French perfume industry, in old traditional perfumes (personnel of scent-manufacturing company associations, pers. comms, May 1998). They mentioned the high price of natural musk as being the main reason for the decline in its use in France.

Musk use in perfumeries outside Europe

Shanghai is known for its musk-based perfumes, which are widely used (J.A. Mills, pers. comm., October 1998).

According to details from associations of scent-manufacturers and A. Vaisman (pers. comm., March 1998), the perfume industries in several Arabian countries and in Russia may be using natural musk in their products. The results of the investigation of legal global trade of natural musk do not, however, indicate any current market for natural musk for perfumes manufactured in Arabian countries.

Use of musk in homeopathy

Homeopathy is still a relatively recent "alternative" discipline in Western medicine. It was developed in the early nineteenth century by Samuel Hahnemann in Germany and is today practised worldwide. An important principle of homeopathy is to prescribe very dilute doses of an ingredient which, in a healthy person, would produce symptoms like those of the disease to be cured. A second important principle is that of the potentisation of substances, according to which they are mixed with a medium, diluted to a certain ratio, and shaken or ground, so that at very high potencies of the medicine not a single molecule of the source substance may be present. For the homeopath, the non-material transfer of energy of the source substances to a medium is sufficient to cure the disease. High-potency homeopathic medicines are generally believed to be more effective than those of lower-potency (Leeser, 1961).

Musk from musk deer *Moschus* spp. was among the substances known to Hahnemann and he was aware of its effect in homeopathic terms (Hahnemann, 1826). Musk has been further tested since, in drug trials on healthy persons (Jörg, 1825; Leeser, 1961 and Müller, 1995) and is believed to affect the nervous system, blood circulation and sex organs, and to have effects on psychic, sensory and motor functions. Musk is applied in homeopathy as a nerve treatment (nervinum) for hysteria, euphoria-like conditions and faints with other associated symptoms (Boericke, 1972; Dewey, 1991; Mandl, 1992; Mezger, 1964 and Stauffer, 1984). Substances with similar effects used in homeopathy include castoreum, platinum, crocus, amber and valerian.

Musk is a rarely used homeopathic medicine (homeopathic manufacturers, pers. comms, March 1998). Like all strong-smelling nerve treatments, musk has only a transitory effect. Leeser (1961) writes that while musk is of short-term help in cases of hysteria-like attacks, it does not remedy the neurotic causes of the suffering.

Germany has a much longer tradition of homeopathy than other European countries, and consequently there are more homeopathy companies based in Germany than elsewhere on the continent. The *Kommission "D" für Arzneimittel der homöopathischen Therapierichtung* (D Commission for Drugs used in Homeopathic Treatment Methods) (1988) has published a monograph on musk, which lists nervous dysfunction among the indications for application of musk. Medicines containing musk are prescribed in Germany in the form of drops, as tablets, or by injection.

Nine manufacturers of homeopathic medicine from Germany, Switzerland, Belgium and the UK and one association of companies producing homeopathic medicines from Germany were consulted about their use of musk in homeopathic medicines in spring 1998. These companies have subsidiaries in Austria, Portugal, USA, Australia, South Africa, Eastern Europe and Scandinavia. In Germany, about a dozen manufacturers reported using musk in homeopathic medicines (homeopathic manufacturers, pers. comms, March 1998). Manufacturers in the UK and Belgium claimed that very little musk was used in their homeopathic medicines, while the Swiss reported using very little or no musk.

Where musk was used in homeopathic medicines, companies usually produced several different medicines that contained musk, sometimes differing in potency. According to interviews with these companies, musk is processed in its pure form or in combination with other substances. The lowest potency that is commercially obtainable is a so-called D3, containing musk in a dilution of 1:1000. At this dilution, only a few milligrammes (mg) occur in a gramme of solution or in a tablet. The more commonly employed potency is a D6 (dilution of $1:10^6$). There are medicines containing musk with a potency of D12 ($1:10^{12}$ dilution) or even much higher. In each case, the medicines contain only tiny traces of musk. A few large manufacturing companies in Germany reported consuming more than five grammes annually and some substantially less, amounting to a total of a maximum of 50 g of musk per annum for the entire German production, the equivalent of two musk glands. The actual volume of use is probably lower than this maximum. In other countries, the demand for musk for processing homeopathic medicines is believed to be significantly lower than in Germany.

Most manufacturing companies using musk for homeopathic remedies stated that they had purchased the musk many years ago and were using old stocks. Only one firm expressed an interest in newly-imported musk. Since the homeopathic industry attaches much importance to verifying the source of its products and would favour receiving a certificate that could testify to the origin of musk, it seems possible that homeopathic drug manufacturers would be keen to purchase musk from farms in China, India or Russia in future. In this way, the authenticity of the musk could be guaranteed as best as possible, as well as the health of the musk deer supplying it, since it would not be killed when the musk was removed.

Credit: V. Homes, TRAFFIC

Homeopathic pills containing musk

A number of manufacturers in Germany and the UK foresee an increase in the use of homeopathic medicines that contain natural substances, particularly in prescription-free medicines. However, future demand for musk in homeopathic drugs is expected to remain static because musk medicines are only prescribed in highly specific cases, which are not common (homeopathic manufacturers, pers. comms, March 1998).

In Germany, homeopathic medicines that contain musk are freely obtainable. In the UK, such medicines are available on prescription only.

Use of musk in traditional East Asian medicine

The effects of musk have been known in Oriental medicine for several thousand years (Pereira, 1857). Today, musk is mainly used in traditional medicine in China, Korea, India and other East, South and Southeast Asian countries. It is used as a sedative and as a stimulant - of the heart, nerves, breathing and sexual libido - to treat a variety of ailments (Chopra *et al*., 1982; Mukerji, 1953; Gaski and Johnson, 1994; Kun-Ying Yen, 1992; Pharmacopoeia Commission of the Ministry of Public Health, 1996 and Zuh, 1989). Some studies have shown that musk stimulates the heart and central nervous system. It is also thought to be effective against snake venom and as an anti-inflammatory agent (Gaski and Johnson, 1994). Musk is cited as an ingredient of 70 patent Oriental medicines in the USA (Gaski and Johnson, 1994), while it is contained in about 300 pharmaceutical preparations in traditional Chinese and Korean medicine (Mills, 1998). It is therefore one of the most frequently used animal products in these traditional forms of medicine. The efficacy of musk is still intensively researched, as is the detection of genuine musk in samples and the possibilities for using natural or synthetic substitutes for musk in TEAM. There are currently three natural substitutes for musk in use in TEAM (from the Muskrat and from two species of civet *Viverra zibetha* and *Viverricula indica* (Mills, 1998)), in addition to synthetics.

The demand for musk for the production of pharmaceuticals is reported to amount to 500 -1000 kg per year, in China alone. This is equivalent to a total of about 100 000 musk deer killed annually (Mills, 1998). With an estimated musk deer population of 600 000 in China, there is obvious concern about the survival of musk deer in China.

In Japan, musk has been particularly important among animal and plant ingredients used to produce children's tonics, medicinal drinks and so-called anabolic drinks (to sustain stamina, for example in sports participants) (Green and Taylor, 1986). In 1985, the use of musk in anabolic drinks and children's tonics ceased under pressure from the government and medicinal use of musk has since then been government-controlled.

Credit: V. Homes, TRAFFIC

Musk and Tiger-bone plaster

Credit: D. Lange

Chinese medicine listing musk in its ingredients

SYNTHETIC MUSK

As stated already, the rarity and expense of natural musk have been major incentives to search for less expensive substitutes, added to which is now the incentive to conserve musk deer (Pilz, 1997). Today, synthetic musk compounds are an integral part of many cosmetics, soaps, shampoos, detergents and cleansing agents, air fresheners and other products with an odour. Like natural musk, they are used as fragrances and fixatives for other fragrances. Currently, about 1000 chemical compounds with the smell of musk are known, but only some 30 are economically important (Rebmann *et al*., 1997). The global industrial demand for synthetic musk compounds is estimated at about 7000-8000 tonnes (t) per year and the market value in 1987 amounted to around US$215 million (Rebmann *et al*., 1997).

The first synthetic musk compounds, the so-called nitromusk compounds, were developed around 1890 (Gebauer and Bouter, 1997). This group of substances belongs to the benzene derivatives which are

technically easy to manufacture. The price for a kilogramme was recently around US$5-20 (Gebauer and Bouter, 1997). Nitromusk compounds do not biodegrade easily and are fat-soluble. After tests, one of these compounds, musk ambrette, was classified as mutagenic and its use banned by the EU in 1995 (Brunn and Rimkus, 1997). Major national and international groups in the cosmetics industry have also recommended a halt in the manufacture and use of another of the compounds in this group, musk xylol, since it might be carcinogenic (Brunn and Rimkus, 1997).

In the 1950s, polycyclic musk compounds were developed (Gebauer and Bouter, 1997). Like the nitromusk compounds they are based on petrochemical base materials. In 1996, polycyclic musk compounds formed about 85% of the artificial musk compounds produced annually and thus constituted by far the largest proportion (Rebmann *et al*., 1997). The price for a kilogramme of polycyclic musk compounds is about US$10-35 (Gebauer and Bouter, 1997). Polycyclic musk compounds are inexpensive and highly durable and so are used as perfume fixatives, for example in detergents. They are also difficult to degrade, and even more fat-soluble than nitromusk compounds, with similar associated risks, i.e. those of absorption into the food chain (Eschke *et al*., 1995 and Rimkus and Brunn, 1996). As for nitromusk compounds, the safety of the intake of these readily fat-soluble substances via the human skin is under discussion.

A third group of synthetic musk substitutes, macrocyclic musk compounds, were discovered in 1926 (Pilz, 1997). These macrocyclic molecules are very similar to those of natural musk. They are clearly superior to other artificial musk compounds, so that they are now used virtually exclusively in perfumes (Rebmann *et al*., 1997). However, the manufacture of these complex molecules remains expensive (Gebauer and Bouter, 1997) and the price for a kilogramme of macrocyclic musk compounds is between US$30 and US$3000 (Gebauer and Bouter, 1997). In 1996, they represented only 3-4% of the worldwide production of artificial musk.

In conclusion, artificial musk compounds constitute the main share of “musk” used in perfume and cosmetics. They are far less expensive than natural musk. The suspected toxicity of nitromusk compounds and polycyclic musk compounds has not, to date, been adequately documented and requires further investigation.

MUSK DEER FARMING AND MANAGEMENT OF MUSK DEER IN ZOOS

Musk deer farming

Musk deer are difficult to manage and breed on farms because of their solitary habits, territorial behaviour and excitable nature (Green, 1989). Experience in managing and breeding the animals and in extracting musk from live animals has been gained in China, India and Russia.

Since 1958, efforts have been made to expand musk deer farming in China (Zhang, 1983). Such farms are located in the areas of Ma Er Kang, Miyalo and Manchuan in the province of Sichuan, in the Zhenping area in Shaanxi province and near Foziling in Anhui province (IUCN, 1984 and Zhang, 1983). According to Green (1989), there are also musk deer farms in the provinces of Qinghai and Shanxi and in Quangxi Autonomous Region, but Sichuan produces about half of the country’s musk from farmed deer. In 1984, there were 21 communal farms and four State farms in the province of Sichuan which, together, held about 1000 musk deer, while some 2000 animals in total were kept in farms in the entire country (Green, 1989).

The economic viability of these farms has been insufficiently studied (Green, 1989). Musk deer require a high quality diet and the rations have to be rich in proteins and carbohydrates and low in fibre (Green, 1987b). The difficulty and cost of maintaining the farms were probably high, and the quality of the musk from farmed animals did not match that from wild musk deer, perhaps because the male deer on the farms

were kept in very small cages (Green and Taylor, 1986). When musk deer farms were first established in China, in the 1960s, the animal losses were high, reaching 60-70% of all wild-caught animals. The animals died from gastro-enteritis and poor husbandry. Young musk deer, which are easier to tame than the adult animals, are particularly prone to such infections if no preventative measures are taken. Pneumonia is another frequent cause of illness. Green (1989) reported that only 17 (53%) of 32 musk deer born in zoos worldwide from 1959 to 1980 survived but, during that period (specifically, 1959-73), the survival rate of young deer on farms in China was reported to have improved. Trials in China proved that Forest Musk Deer were easier to domesticate than Himalayan Musk Deer (Green, 1989). Some farms were exclusively for breeding, while in others the musk was removed from the deer. Green (1989) reported that the number of musk deer farms in China was still growing, as demand for musk continued to rise, but this may no longer be the case. A new report on musk deer farming in China is expected to be completed soon by TRAFFIC-East Asia, which will shed more light on the current activities of China's musk deer farms.

Since 1965, there have been attempts in India to domesticate musk deer for the purposes of musk extraction from live animals at Kufri in Himachal Pradesh, and at Kanchula Kharak and Meroli, in northern Uttar Pradesh (Bhadauria, 1990 and Green, 1989). These musk deer farms were under government control and reportedly do not operate very effectively (Sathyakumar *et al*., 1993).

Russia has also planned a programme for captive musk deer management (Prikhod'ko, 1997 and Prikhod'ko and Ovsyanikov, 1998). The management and breeding of animals in the Altai and Sayan Mountains appears promising, because the cost of managing and feeding could be kept low: in the opinion of Prikhod'ko (1997), 10 000-15 000 musk deer could be managed in captivity in Russia at comparatively low cost and small farms with 20-25 musk deer could be profitable.

Capturing musk deer and extracting musk from live animals

Experience with musk deer has shown that populations bred in captivity, as with captive collections of many animal species, regularly require replenishment with wild animals (Green and Taylor, 1986). At present, there are no efficient methods of capturing live musk deer. Kattel and Alldredge (1991) proposed large nets, six metres long by two metres wide, used by a team of 10-15 people. Using this method, 50% of catching attempts were successful. Once captured, the musk deer were sedated.

Flerov (1952) and Zhang (1983) describe the extraction of musk from the live animal, using a spatula that is inserted into the musk sac via the external orifice while the animal is manually restrained (Flerov, 1952 and Green, 1989). The procedure takes a few minutes, and the opening to the musk sac is afterwards treated with an antibiotic cream. The extracted musk is dried, weighed and sealed in an airtight container. Because of their susceptibility to stress, the extraction should initially be carried out under anaesthesia, until the animals are sufficiently tamed (Green, 1989).

The collection of musk from wild musk deer could form a substantial contribution for the income of people in rural areas, and could at the same time encourage the protection of musk deer populations and their habitat (Green and Taylor, 1986). It is precisely in rural areas that earning cash is difficult and that the temptation for poaching and smuggling is significant (P. Fomenko, *in litt.*, March 1998 and Jackson, 1979).

Musk deer in European zoos

Musk deer are rarely kept in zoos. Their shy, inconspicuous lifestyle makes them little attractive to visitors. Except for one musk deer farm near Moscow, Leipzig Zoo in Germany is the only zoo in Europe that breeds Siberian Musk Deer, which it has been doing since 1980. Musk deer are also kept in zoos in Berlin, in Paris, and in northern Italy, but have not bred.

Staff at the Leipzig Zoo responsible for the keeping of musk deer reported that they considered the establishment of successful musk deer farms to be feasible (staff at Leipzig Zoo, pers. comms, 1998)[3] (see **Footnotes**). Zoo keepers and the curator for ungulates at Leipzig Zoo report that managing and breeding musk deer is without problem once the animals reach maturity, for although juvenile mortality can be high, as the animals grow older the incidence of mortality falls off dramatically (F. Meyer, B. Schneider and G. Nötzold, pers. comms, April 1998). The zoo now has five musk deer in two groups (Müller and Eulenberger, 1995) and since 1980, over 40 musk deer have been born, although 50% of all musk deer born in the zoo died in their first year. The oldest musk deer born at the zoo is now nine years old. According to Müller and Eulenberger (1995) and Seidel (1993), it is primarily infectious diseases which kill the musk deer in zoos. In-breeding at Leipzig Zoo has not so far been a problem, but the zoo is nevertheless trying to incorporate musk deer from other sources into their breeding programme (F. Meyer, pers. comm., April 1998).

CONCLUSIONS

The biology of musk deer species is little understood and their taxonomy remains unsolved. Knowledge of their distribution is incomplete and the population sizes of the different species most uncertain in several cases. In many range countries laws to protect musk deer and their habitats exist and musk deer populations can reproduce quickly relative to other large mammals, given suitable environmental conditions, yet in practically all countries in Asia where musk deer occur, wild populations are declining because of overexploitation to meet the high demand for musk.

Musk deer and musk trade

Worldwide

A large variety of musk deer products is found in worldwide trade but most were found to be derivatives, mainly in the form of traditional East Asian medicines, and raw musk. From 1978-96, 35 countries exported or re-exported specimens of musk or other musk deer products, according to CITES annual reports. Nine of them were musk deer range States and seven exported raw musk. Of these exporting range States, the Soviet Union, Russia and Mongolia were the most important exporters of raw musk. Between 1978-96, 42 countries were recorded as importing musk products, according to CITES annual reports. Thirteen countries reportedly imported raw musk, of which Hong Kong, Singapore, South Korea, Japan, France and Canada were the most significant importers. Of these, Canada may be a mistake. South Korea, Japan and France apparently consumed most of their imported musk, or re-exported it in a processed form, while Hong Kong and Singapore acted as entrepots. Six countries reportedly re-exported raw musk.

The role of Asia

According to reports from literature and European musk traders, the demand for musk in Asia is still growing. South Korea, for example, appears to play an increasingly important role in the international musk trade, notably for consumption, and the already high level of demand for musk in South Korea in 1998 is expected to continue to rise. East and Southeast Asia, as a whole, constitute the largest market for musk. China has a high domestic demand for musk, reportedly 500-1000 kg/year, and the majority of musk that is locally used in medicine originates from within the country from both legal and illegal sources: China does not show up as a major international trader of raw musk, but according to CITES annual reports it was the biggest exporter of musk derivatives. Japan may still be a major consumer, of musk medicines in particular, and, moreover, Japan could be far more significant an importer than CITES data show. Hong Kong, Singapore and Cambodia act as notable re-export centres of musk: the origin of several hundred kilogrammes of musk traded by Cambodia is totally unknown. In India, although hunting

for musk deer is prohibited by law, Indian musk products continue to appear on the domestic and international market. Mongolia is of note for having exported substantial quantities of musk in the mid-1990s to South Korea. It is not clear if this amount was harvested in Mongolia itself or in a neighbouring country (for example, Russia or China) from where it was traded, legally or illegally, to Mongolia.

The role of Russia and other CIS countries

In theory, a workable model for the sustainable exploitation of wild musk deer populations exists in Russia, based on the system of licensed musk deer hunting, but the fact that export quotas for musk from Russia are decreasing annually may indicate that populations of the deer in Russia have been falling significantly for years. Moreover, the fact that the officially reported exports of musk from Russia in 1995 exceeded the official export quota set for the year reveals the shortcomings in the control of exploitation of musk deer in Russia.

The Siberian Musk Deer, although still a widespread species, has a rapidly declining population, currently estimated at 47 000-52 000 animals. Most of the population is threatened by commercial exploitation. The 4000-5000 musk deer estimated to remain in the Russian Far East are acutely threatened by reduction of their habitat as well as by hunting, legal and illegal, to supply the trade in musk. There is a significant amount of illegal trade in musk in the Altai region and in the Russian Far East and the amount of musk from this region traded with China and South Korea, in particular, is probably significant.

In the regions of the Altai and Sayan Mountains, the establishment of farms is regarded as particularly promising and it would appear to be possible to manage 10 000-15 000 musk deer on Russian farms at comparatively low cost.

Musk deer may occur in Kyrgyzstan in very low numbers but Uzbekistan is not a range State of musk deer, and it would appear unlikely that more than one hundred kilogrammes of musk could be harvested from Kyrgyzstan. The amounts of musk that were reportedly exported from these countries may therefore actually have originated elsewhere - in all likelihood in the Russian Federation.

The role of Europe (excluding Russia)

Germany, Switzerland and France play a significant role in the international trade in musk and France has, at least in the past, consumed musk and is reported to use a small amount still, for the perfume industry. Above all Germany and, to a lesser degree, Switzerland became important intermediate traders of musk in the first half of the 1990s. Virtually all of the musk traded by these two countries originated from Russia or, formerly, the Soviet Union. The pre-existing economic relations between Germany and Switzerland, on the one hand, and Russia, on the other, and the financial strength and security of Germany and Switzerland in the 1990s may help to explain the development of these trading links. Before 1996, over 90% of musk imported to France (approximately 97 kg) was probably processed in France itself, where it is highly likely that a large proportion entered the perfume industry. In 1996 and 1997, however, France imported musk from Russia, which it re-exported to Hong Kong. Almost all the musk imported by Germany, 1994-96, (approximately 60 kg) and Switzerland, 1989-95, (approximately 12 kg) was re-exported to East and Southeast Asia.

Illegal trade

There are reports from literature and from musk traders of a high level of illegal trade in Russia and other CIS countries. There have been few seizures of illegal shipments of musk in France, Germany and Switzerland. The majority of musk confiscated in Europe was in the form of medicinal products manufactured in Asia. Several hundred of these products containing or purporting to contain musk were confiscated

during the 1990s in Germany, UK, Belgium and the Netherlands as they lacked the necessary CITES permits. From 1978-96 there were no musk derivatives recorded in trade to European countries, except for reports of trade from China in 1990-92, unconfirmed by the European countries. It follows that most products which contained musk or claimed to contain it which appeared on the market in Europe during that period were probably illegally traded.

Use of musk

Most perfumers and other experts in the perfume industry agree that very little natural musk has been used in Germany and Switzerland for a number of years now. Even France's perfume industry is increasingly replacing natural musk with substitutes, although some of the most traditional and most expensive perfume houses are still using anything between hundreds of grammes and some kilogrammes per year of natural musk in their products. The high price of natural musk, uncertainty about constancy of supplies and consumer demand for products without animal derivatives are rendering natural musk increasingly unattractive as an ingredient for perfumes. Synthetic musk imitates the characteristics of natural musk sufficiently faithfully so that a complete cessation of use of natural musk in the perfume industry is possible within a few years. Some synthetic musk compounds may, however, have harmful effects on the environment themselves, leaving open the possibility that some companies will continue to process natural musk, for instance for particularly expensive perfumes or in perfumes developed for particular individuals. Clear product labelling of perfumes containing natural musk and accompanying CITES permits would facilitate enforcement efforts in this context.

The incidence of natural musk in perfumes is expected to continue to decline in Europe, according to industry representatives consulted, but there are indications that natural musk may be used in Russia's perfume industry according to A. Vaisman (pers. comm., March 1998), as well as in that of Shanghai and Arabian countries.

Analysis of the use of musk in homeopathy revealed that it is small-scale for this form of medicine. For example, a few grammes of musk are sufficient to meet the annual demand of homeopaths in Germany and for German production of medicines for export. Switzerland and the UK also have very low demand of only a few grammes of musk, per annum, each, for homeopathic purposes. Musk from a maximum of 10 animals, and probably fewer, would be sufficient to meet the annual needs of the European homeopathic market. Although the growing Indian and North American homeopahtic markets have not been assessed, a rise in demand for musk for homeopathic medicine is unlikely because musk medicines are only prescribed in highly specific cases, which are not common.

Musk still is used in some hundreds of traditional East Asian medicines, mainly in China, Korea, India and other East, South and Southeast Asian countries, to treat a variety of ailments. It is therefore one of the most frequently used animal products in TEAM, making it very difficult to find a suitable natural or synthetic substitute for the treatment of such a variety of complaints.

Synthetic musk

Today, synthetic musk compounds are an integral part of many cosmetics, soaps, shampoos, detergents and other products with an odour. Like natural musk, they are used as a fragrance and also as a fixative for other fragrances. Some 30 chemical compounds are economically important. Artificial musk compounds constitute the main share of "musk" used in perfume and cosmetics. They are far less expensive than natural musk. The suspected toxicity of nitromusk compounds and polycyclic musk compounds has not, to date, been adequately documented and requires further investigation.

Musk deer farming and extracting musk from live animals

Musk deer are difficult to manage and breed on farms because of their solitary habits, territorial behaviour and excitable nature. Experience in managing and breeding the animals and in extracting musk from live animals has been gained in China, India and Russia.

There are methods already developed to extract musk from live animals in the wild. The collection of musk from wild musk deer could form a substantial contribution to the income of people in rural areas, and could at the same time encourage the protection of musk deer populations and their habitat. It is precisely in rural areas that earning money is difficult and the temptation for poaching and smuggling is significant. Musk deer farming and extracting musk from live animals in the wild could lead to sustainable production of musk from musk deer.

RECOMMENDATIONS

Action in the following categories could be taken to improve the conservation of musk deer in the wild. The most important action would be to reduce the use of natural musk by increasing public awareness of the conservation concerns surrounding musk deer. Use of natural musk obtained by hunting wild deer should also be reduced through use of substitutes, including musk from farmed deer and musk taken from live wild deer.

Improvement of scientific information on the conservation status of musk deer

In this context,

- Accurate assessments of musk deer populations and their conservation status should be urgently undertaken in Afghanistan, Pakistan, Bhutan, Myanmar, Vietnam, North and South Korea, Russia, Kazakhstan, Kyrgyzstan (possible range country), China, Mongolia, India and Nepal. These assessments of musk deer populations are most urgently needed in China, Mongolia and Russia, because these are the range countries where use and export of musk occur in significant quantities. In Russia, scientific field studies and properly conducted counts of musk deer need to be carried out to examine the ecology and conservation status of individual subspecies, as a basis for their protection and sustainable exploitation. This report recommends the results of such assessments to be presented to the 11th meeting of the Conference of the Parties.

- Accurate information should be compiled on the western distribution range of *Moschus* spp., to clarify whether Kyrgyzstan is a valid range country.

- The taxonomy of various musk deer species should be clarified, in particular because recommendations for legal actions under CITES are established at species level. Molecular genetics and other laboratory methods could assist in distinguishing species as well as in identifying musk in derivatives, and perhaps to help differentiate between musk originating from CITES Appendix I-listed musk deer species from that derived from Appendix II-listed musk deer species.

Investigation of harvest, trade and demand in musk deer range countries

- Surveys of the domestic markets for musk deer in China, South Korea, India, Nepal, Vietnam, Mongolia and Russia, should be undertaken as priorities, but the demand for musk, and its harvest and legal and illegal trade should be surveyed in all musk deer range countries and the possibilities determined for reducing demand for musk from wild deer. This report recommends the results of such surveys to be presented to the 11th meeting of the Conference of the Parties. For example:

- Accurate market analyses of the use of musk in traditional medicine in Asia are needed so that the level of the demand, the market characteristics, trends and user groups can be better identified and monitored. If sustainable use concepts and attempts to harness market forces to improve long-term management are to be successful, they have to be developed and implemented using a participatory approach where the relevant stakeholders are concerned.

- In India and in other countries in the Himalayas domestic and overseas demand for musk should be identified, as well as the trade routes and stakeholders. The level of poaching and smuggling should be determined, the main incentives for hunting and trading musk assessed.

- Studies are needed to clarify the significance of poaching and of illegal trading in musk in key regions along the border area between Russia and China, Mongolia, Kazakhstan and North Korea.

Improvement of legal protection for musk deer in range countries

¤ Although more accurate information is required regarding the conservation status of musk deer (see first recommendation), appropriate measures to protect musk deer need to be taken in musk deer range countries straightaway. *In situ* protection of different species and subspecies of musk deer should be strengthened, particularly for highly threatened populations, such as the Sakhalin Musk Deer in Russia, Mongolian musk deer populations and Himalayan populations in China, Nepal and India. The range countries should enact and enforce suitable protection laws for these species and sub-species of musk deer where these are lacking and create effective protected area systems. Given the lucrative rewards associated with the poaching of musk deer, additional funds and information should be made available by governments to managers of protected areas, for personnel involvement in anti-poaching operations, in order to combat the threat to musk deer and other species.

- In Russia, Prikhod'ko (1997) describes a series of national measures which will need to be undertaken to protect the Siberian Musk Deer in different regions of the country, namely the creation of a network of protected areas and a ban on commercial hunting within their boundaries, particularly in the regions of Kemerovsk, Krasnoyarsk, Chakasi, Irkutsk and in the south of Yakut-Sakha. A minimum size of 450-500 km^2 per protected area, with a musk deer population of at least 350-370 animals per area is recommended, as proposed by Prikhod'ko (1997). The habitats of the Sakhalin Musk Deer on Sakhalin Island and those of the subspecies in the Russian Far East - the Bureiskii regions and the Amgun river basin - should be declared protected areas.

- Once scientific studies have identified the level of vulnerability of the different subspecies of musk deer in Russia, a complex and regionally focused conservation programme should be initiated on the basis of the findings. Meanwhile, the Verkhoyanski subspecies of musk deer should be included in Russia's Red List, and a ban on capturing of the animals in the Republic of Yakut-Sakha and in the Magadan region should be enforced, (as recommended by Prikhod'ko (1997)). The existing legal protection for the only subspecies of musk deer on Russia's Red List, the Sakhalin Musk Deer, should be better implemented. It is necessary to list the subspecies that lives in Russia's Far East on Russia's Red List and commercial capture of this subspecies should be prohibited for 10 years in the Amur, Khabarovsk and Primorye regions, while non-sustainable timber harvesting in forests in the area should be restricted, as has been recommended by Prikhod'ko (1997).

- In addition to the creation of protected areas, the banning of hunting in certain areas, and the listing of musk deer taxa in the Russian Red List, it will be necessary to protect the wild musk deer populations in Russia from over-hunting by revising the regulatory system for the exploitation of musk deer in the country. The present scheme dates from the Soviet times when strong centralised controls were in force, but now needs urgently to be updated and improved, in terms of its scientific basis; in terms of monitoring by independent government bodies and non-governmental organisations (as, for instance, with the counting of Tigers in the Russian Far East by WWF); in terms of involvement of local people and stakeholders; and in terms of decentralisation of its administration. Linked to any improvement in the system for regulating hunting must be a strengthening of measures to combat poaching and illegal trade in Russia

- Russian export quotas for musk need to be based on solid scientific data and kept at the lowest possible levels for at least a few years until wild populations have had a chance to recover and reliable field assessments have resumed. Close on-the-ground monitoring, possibly by independent governmental or non-governmental organisations, is needed so that quota levels may be adapted to reflect the status of targeted populations.

- The accession to CITES of Bhutan, Kazakhstan, Kyrgyzstan, and North Korea should be encouraged, to further improve the protection of musk deer *in situ* by attempting to improve the controls over international trade in musk.

- In Kazakhstan and Kyrgyzstan (if it is a range country for musk deer), licensed hunting should be introduced. Scientifically-based population censuses of musk deer should form the foundation for plans for the adequate protection of musk deer species in Kazakhstan and Kyrgyzstan. If population counts of musk deer indicate that some exploitation is possible, annual export quotas should be set on the basis of scientific evidence. Without scientific evidence from the field, zero quotas for musk export are recommended.

Sustainable use initiatives and farmed deer

¤ Projects that can demonstrate sustainable harvests of musk from farmed and/or wild animals should be promoted as models to emulate. Such projects should involve local people. Farm operators should be encouraged to share information with interested parties and a portion of the profits from such schemes should be used to foster wild musk deer conservation. Through such schemes, musk deer, as well as their sensitive habitats, could be protected in a sustainable way, as proposed by Green (1989 and 1998) .

¤ The Chinese policy on musk deer farming needs to be reviewed and, where applicable, developed into an economic and species-appropriate management concept.

¤ The existing plans for the extraction of musk from captive musk deer in Russia should be supported and, if economically feasible, transformed into a private business with management plans and initiatives.

¤ An exchange of scientific and practical information relating to the management and breeding of musk deer on farms should be set up between China and Russia. Such knowledge should be made available to other relevant countries, for example, North and South Korea, too. Commercial or other forms of compensation for such transfers of knowledge could be negotiated.

Regulation of trade in musk in non-range countries

- Importing countries such as Japan, Hong Kong, Singapore, South Korea, USA, Australia, France, Germany, Switzerland and others should be required to assist the countries of origin by means of financial or technical assistance to safeguard and monitor wild musk deer populations.

- The main destination countries for raw musk in international trade (South Korea, Japan and France) and re-exporting countries (Hong Kong, Singapore and recently also Germany, Switzerland and Cambodia) should enforce all CITES provisions pertaining to musk.

- In order to assist the country's recent accession to CITES, the role of Cambodia in the international trade should further be monitored since Cambodia seemed to export significant volumes of musk in 1994 and 1995.

- The significance of Hong Kong, Singapore, Taiwan, Japan and Cambodia in the international trade in, and use of, medicines containing musk should be examined in greater detail, and enforcement loopholes in these locations should be identified and closed.

- Enforcement loopholes in Europe relevant to the international trade in musk derivatives should be detected and eliminated by the competent authorities and organisations in Europe. For example, proposals for labelling of products containing musk should be developed jointly with the traders and authorities in the countries of origin and forensic techniques should be developed to determine the presence or absence of musk in derivatives.

Use of musk and musk products in Asian medicinals, perfumes and homeopathic products

- Most musk derivatives are traded for Asian medicinal purposes, but the level of Asian medicinal consumption of musk needs to be clarified to better understand the existing and expected market needs. Surveys to ascertain these are particularly recommended for South, East and Southeast Asian countries and should also include New Zealand, Australia, Canada and the USA.

- The domestic demand for TEAM should especially be investigated in China, South Korea and Japan, which are probably the main consumers.

- Until the presence or absence of genuine musk in Asian medicines is clarified, all items that claim to contain musk should be traded with CITES permits. Clear product labelling would be useful for enforcement purposes.

- The research on musk substitutes for use in TEAM needs to be encouraged, intensified, and, as far as possible, lead to practical and acceptable solutions that could be supported by user groups of all kinds of Oriental medicine.

- Although it seems likely that the demand for musk in the perfume industry in Europe is decreasing, this requires monitoring.

- Perfumes that contain natural musk should be required to be accompanied by appropriate CITES permits when in international trade. Clear product labelling would facilitate enforcement efforts in this context.

- An examination of the trade and use of musk in Russia should take the local perfume industry into account. The use of musk in the perfume industries of Russia, China and some Arabian countries should be investigated and documented.

- Since the amount of musk used in homeopathic medicine is very low, because in many homeopathic medicines the potency is so high as to make it impossible to identify musk in the product, and since it is not very likely that use of musk in homeopathic remedies will rise significantly in the future, it is not recommended that homeopathic products containing musk need CITES permits when in international trade.

GLOSSARY

CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIS:	Commonwealth of Independent States, a confederation of independent states, formerly constituent republics of the Soviet Union
North Korea:	Democratic People's Republic of Korea
IUCN:	The World Conservation Union
IUCN/SSC:	Species Survival Commission of IUCN
IUCN/TSG:	Trade Specialist Group of IUCN
Russia:	Refers to the Russian Federation, unless otherwise stated
South Korea:	Republic of Korea
TEAM:	Traditional East Asian medicine
WCMC:	World Conservation Monitoring Centre
WWF:	World Wide Fund for Nature

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FOOTNOTES

1 *The data is based on population counts made in 11 regions in 1967/68. In the Irkutsk region the population density of the musk deer was 0.11 animals per. km², in Chitais 0.24 animals per km², in Buryatia 0.3-0.7 animals per km² and in the Amur region 0.26 animals per km². The highest population density of up to 2 animals per km² was recorded in the Sayan and Altai Mountains.*

2 *The following protected areas are located within the distribution range of musk deer in Russia*: *one national park, 21* zapovedniks *and five other protected areas* (Wemmer 1998). *In the territory of the Russian Federation, musk deer occur in protected areas in the Komsomolskiy, Sikhote-Alinskiy, Ussuryskiy and Zeyskiy* zapovedniks *and in the Altaiskiy, Baikal'skiy, Barguzinskiy and Bol'shekhekhtsizskiy* zapovedniks.

3 *The animals are fed oat flakes, crispbread and plant-feeder pellets, in addition to shredded vegetables (kohlrabi, beetroot, carrots), fruit and green leaves (F. Meyer, pers. comm., April 1998). The available cover in the enclosure is more important for the animals than the size of the enclosure. Anaesthetising sick musk deer with the aid of a blowpipe (with an anaesthetic mixture comprising xylazine and ketamine) is likewise seen to be a straightforward matter (Müller and Eulenberger, 1995). Individual animals can be anaesthetised several times in succession without incurring injury.*

APPENDIX 1

Seven countries involved in the export of musk with a total volume of international trade of more than 100 kg (1978-96)

Year	Musk deer non-range countries						Musk deer range countries							
	HK-E	HK-I	KH-E	KH-I	UZ-E	UZ-I	MN-E	MN-I	SU-E	SU-I	RU-E	RU-I	KG-E	KG-I
1978										37				
1979	11									29				
1980	1									5				
1981	7									2				
1982														
1983	6									52				
1984	12.5									10				
1985	134								46	10				
1986	12.5								30	50				
1987	87.5	7							81	40				
1988	131	14							80	77				
1989	25.5	3.5	10	20										
1990	27.4	14								10				
1991	13	5							36	15				
1992	105	2.1								7	21			
1993	13	8									6.2	23.2		
1994	6	6		114		51		100			50.7	41		
1995		11		298		75		250			94.7	10		125
1996												38.7		

Trade volumes in kilogrammes (kg). E: reported by exporting country/territory, I: reported by importing countries/territories. HK: Hong Kong; KH: Cambodia; MN: Mongolia; SU: Soviet Union; RU: Russia; KG: Kyrgyzstan; UZ: Uzbekistan.

APPENDIX 2

Six countries involved in the import of musk with a total volume of international trade of more than 100 kg (1978-96)

Year	HK-I	HK-E	SG-I	SG-E	KR-I	KR-E	JP-I	JP-E	FR-I	FR-E	CA-I	CA-E
1978	37.1											
1979	29							1				
1980	5									1		
1981	3							6				
1982												
1983	52							6				
1984	10			0.5				9		3		
1985	10	10				2		46	10.1			122
1986	50	30				1		11	11			0.5
1987	40	81	5	8		15		62.5	2	2		
1988	87	40		41		2		110	15	14		
1989	10	10	10				2.17	17	8.5	8.5		
1990	18	8	1	1				13	14	14		
1991				21		5		12	15	15		
1992	19	32						5	9.1	102		
1993	23.2	5.2			29			5	8	3		
1994	17	21.8	17	17	290	18	10.3	5				
1995		11.8	10	12	759.5	6.3	6	3.4	4			
1996		22		16								

Trade volume in kilogrammes (kg) I: reported by importing country/territory. E: reported by exporting countries/territories; HK: Hong Kong; SG: Singapore; KR: South Korea; JP: Japan; FR: France; CA: Canada.

IUCN
The World Conservation Union

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 monitor trade in wild plants and animals. It works in close co-operation with the Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

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