

Review of Significant Trade *Aquilaria malaccensis*

(November 2003)

Aquilaria malaccensis Lam. (1783).

Synonyms¹:

Agalochum malaccense (Lam.) Kuntze

Aquilaria agollocha Roxb.

Aquilaria secundaria DC.

Aquilaria malaccense Thiegh.

Agarwood

Bois d'aigle de Malacca

Madera de Agar

Order: MYRTALES

Family: THYMELAEACEAE

1. Summary

Aquilaria malaccensis is one of 15 tree species in the Indomalesian genus *Aquilaria*, family Thymelaeaceae. It is a large evergreen tree growing up to 40 m tall and 1.5-2.5 m in diameter, found typically in mixed forest habitat at altitudes between 0 and 1000 m above sea level. The species has a wide distribution, being found in Bangladesh, Bhutan, India, Indonesia, Malaysia, Myanmar, the Philippines, Singapore and Thailand. *A. malaccensis* and other species in the genus *Aquilaria* sometimes produce resin-impregnated heartwood that is fragrant and highly valuable. There are many names for this resinous wood, including agar, agarwood, aloe(s)wood, eaglewood, *gaharu* and *kalamabak*. This wood is in high demand for medicine, incense and perfume across Asia and the Middle East.

The 2002 IUCN Red List classifies this species as Vulnerable. It has been harvested heavily throughout its range, perhaps with the exception of Singapore where it is classified as Rare in that island's totally protected national parks. The major threat to wild populations is unregulated and often illegal harvest and trade, although further research and monitoring would provide data about the species' ability to regenerate in over-harvested areas. A secondary threat is logging for timber in forested areas that overlap with habitat for this species. No population estimates are known for any range State.

A. malaccensis receives differing degrees of habitat protection throughout its range under various countries' systems of national parks and protected areas. Harvesting is regulated in some form under the forest laws of India, Indonesia, and Malaysia, and the species is totally protected under the forest laws of Bhutan, Myanmar, Philippines, Singapore and Thailand. The export of native *A. malaccensis* products, except oil, is currently banned in India. Bangladesh has no protective legislative provisions in place for harvest and trade of *Aquilaria* spp., while the status of habitat protection in that country remains unknown. Indonesia is the only range State that is known to set quotas for the harvesting and trade of *A. malaccensis*, which for 2003 are set at 50 t, but the scientific basis for this quota remains unclear. Indonesia's harvest quota for *A. malaccensis*, however, includes four other species, namely *A. beccariana*, *A. hirta*, *A. microcarpa* and *Gyrinops versteegii*. In all range States, mechanisms to monitor populations and details of how regulations governing protection, harvest and trade are enforced are largely unknown.

¹ Synonyms follow those listed for *Aquilaria malaccensis* in the CITES Identification Manual (Anon, 2001)

The historical movement of harvest and trade sources for the global agarwood market (all species) has moved progressively eastwards from India, through mainland Southeast Asia, to Sumatra and Borneo, and since 1997 has been characterized by large sources of supply from the island of New Guinea. Initially this took the form of *Aquilaria filaria* from Papua (formerly Irian Jaya) but Papua New Guinea has begun reporting agarwood exports sourced from *Gyrinops ledermannii* to Singapore since 1999. UNEP-WCMC CITES data shows that Indonesia and Malaysia remain the two most important suppliers of agarwood designated as being from *A. malaccensis* to the international market, reporting exports of 1,043 t and 2,420 t respectively between 1995 and 2001. Singapore's role as a re-exporter of *A. malaccensis* (mostly in the form of chips, powder/dust, and timber) from these two countries remains paramount in the overall global trade dynamics, with reported re-exports from Singapore totaling 1,448 t between 1995 and 2001. Thailand also reported exports of *A. malaccensis* in 1997. Hong Kong S.A.R. and India also play important roles as re-exporting and consuming States. Taiwan (Province of China) is the most important final destination market for *A. malaccensis*, and its Customs data reveal that it is also a substantial importer of agarwood from other *Aquilaria* spp. Other significant final destination markets include United Arab Emirates (UAE), Saudi Arabia and Japan. In addition to Indonesia's mixing of other agarwood-producing species with its exports of *A. malaccensis*, Malaysia (Sarawak) has listed *A. beccariana*, *A. microcarpa*, *Aetoxylon sympetalum* in mixed quantities with exports of *A. malaccensis*, and Singapore reports difficulties in distinguishing *A. malaccensis* from *A. filaria*, (although it is highly likely that difficulties are experienced distinguishing *A. malaccensis* from most other agarwood-producing species), leading to the conclusion that species identification at product level during import, export or re-export is extremely difficult, if not impossible for all agarwood-producing species.

Plantations of *Aquilaria* spp. are reported to exist in Bangladesh, Bhutan, India, Indonesia, Malaysia, Myanmar and Thailand. The potential to link artificial propagation with the inoculation or treatment of trees to stimulate agarwood formation would appear to offer the best chance to take pressure off wild populations by reducing the incidence of indiscriminate felling of trees in the search for agarwood.

Background

Aquilaria malaccensis first came to the attention of the Plants Committee in the late 1990s, when the Committee determined that a review of the implementation of the CITES Appendix-II listing for *A. malaccensis* was a priority under the CITES significant trade process for plants for the period 1998-2000. TRAFFIC was hired as the consultant to prepare a review of CITES implementation for the species, and an interim report was submitted to the 9th Meeting of the Plants Committee (Darwin, June 1999), with the final report circulated to range States in September 1999. The results of that report led to a number of Decisions being adopted by the Conference of the Parties at their 11th meeting (Gigiri, April 2000) and 12th meeting (Santiago, November 2002). The Decisions that are currently in effect (Decisions 12.66 to 12.71) are all directed to the Plants Committee requesting it: to ensure the development of identification tools based on DNA analysis; to compile more detailed information on distribution; to ensure that studies include all agarwood producing taxa; to invite IUCN to re-evaluate the threat status of all agarwood producing taxa; to develop a standard method for determining population status and making non-detriment findings in compliance with Article IV of the Convention; and to conduct further field studies on trade dynamics in selected countries.

The findings also indicated that *A. malaccensis* warranted formal review through the Review of Significant Trade in compliance with Resolution Conf. 12.8 on Review of Significant Trade in specimens of Appendix-II species, which resulted in the compilation of the present report.

2. Species Biology and conservation status

2.1 Life History and Ecology

Aquilaria species have adapted to live in various habitats, including those that are rocky, sandy or calcareous, well-drained slopes and ridges and land near swamps. They typically grow between altitudes of 0-850 m, and up to 1000 m in locations with average daily temperatures of 20-22°C (Ding Hou, 1960; Afifi, 1995; Keller and Sidiyasa, 1994; Wiriadinata, 1995).

A. malaccensis starts to flower and produce fruit at the age of 7-9 years in north-western India, and medium sized trees are reported to produce about 1.5 kg of seed during good seed years. The species is shade-tolerant when young and may regenerate in almost pure patches

underneath mother trees (Beniwal, 1989). The average diameter growth rate of *A. malaccensis* in native forests in Malaysia is rather low, e.g. a mean of 0.33 cm/ year, but the fastest-growing larger specimens are reported to grow at 0.8-1 cm/year (La Frankie, 1994).

Ding Hou (1960) records *A. malaccensis* as a tree that grows to 40 m in height with a 60 cm diameter trunk. A study conducted from 1996-98 of the reproductive ecology of six *Aquilaria* species, including *A. malaccensis*, examined the phenology and seed production at two sites, (i) a botanic garden; and (ii) a plantation in Bogor, Indonesia, while also studying seed production and dispersal in Kalimantan, Indonesia, on the island of Borneo. The study concluded that *Aquilaria* was a typical understorey tree, that mature *A. malaccensis* can grow to 40 m in height, and that flowering and fruiting occurred in the dry season (when observed in Indonesia's Bogor Botanic Garden). Patterns of seedling distribution indicate that few seeds are distributed more than a few meters from the adult tree. Under nursery conditions, seeds of *Aquilaria* spp. germinated rapidly and a relatively high proportion of seed eventually germinated (>50%). The authors concluded that if such high germination rates could be reproduced under forest conditions, the potential for seedling recruitment would also be high. However, they noted that the results should be treated with caution given the relatively small sample size and the fact the observations were confined to a single season (Soehartono and Newton, 2001a).

Research into the formation of agarwood continues, but the general understanding is that the fragrant oleoresin that permeates the heartwood of some trees is produced as a response to wounding and/or fungal infection. Gianno (1986, cited in LaFrankie, 1994) suggested that only 10% of mature *Aquilaria* trees above 20 cm diameter at breast height (dbh) produce agarwood. Chakrabarty *et al.* (1994) stated that infected trees produce resin from the age of 20 years onwards, while Sadgopal (1960, cited in Soehartono and Mardiastuti, 1997) suggested that trees aged 50 years and over produce the best yields of agarwood.

Uncertainty about the size/age of trees when they reach reproductive maturity has caused speculation that the current practice of harvesting adult trees is likely to be detrimental to the viability of the population. Establishing long-term ecological plots in various habitats would provide useful data to test this hypothesis, as would further research into the flowering phenology of the species (L. Chua, Forest Research Institute Malaysia, *in litt.* to TRAFFIC Southeast Asia, May 2003).

2.2 Global Distribution and Conservation Status

A. malaccensis is widely distributed in south and southeast Asia. There are differing accounts of the countries in which it occurs. Oldfield *et al.* (1998) listed 10 countries as range States for *A. malaccensis*: Bangladesh, Bhutan, India, Indonesia, Iran, Malaysia, Myanmar, Philippines, Singapore and Thailand. This review has confirmed that Iran has no records of the species occurring in that country (see below), which verified previous reports that questioned this as a projected western extreme of the species range (Soehartono, *in litt.* to TRAFFIC International, 2000; Heuveling van Beek, *in litt.* to TRAFFIC International, 2000). The supporting statement that accompanied India's 1994 proposal to include *A. malaccensis* in the Appendices of CITES named Lao PDR and Viet Nam as additional range States. However, while both countries are known to be range States for *A. crassna*, no evidence was found during this review, or during the CITES review of 1999, that they are range States for *A. malaccensis*, and therefore they are excluded from this review. Brunei Darussalam was also contacted for this review to confirm which *Aquilaria* species was present in its territory, and confirmed that there was no record of *A. malaccensis*.

A. malaccensis is included in *The World List of Threatened Trees* (Oldfield *et al.*, 1998). The 2002 IUCN Red List classifies this species as Vulnerable (VU A1cd) based on a population reduction of at least 20% over the last three generations caused by actual or potential levels of exploitation, as well as a decline in the area of occupancy, extent of occurrence and/or quality of habitat (Hilton-Taylor, 2002). This classification is based on an assessment undertaken in 1994. A review of the current global status of agarwood-producing taxa is considered a priority activity by the Plants Committee and subsequently, Decision 12.69 was adopted at the Twelfth Meeting of the Conference of the Parties (Santiago, 2002). The text of the Decision states that "IUCN should be invited to re-evaluate the threatened status of all agarwood producing taxa according to the 2000 IUCN criteria". Unfortunately, at the time of writing, no funding had been secured by IUCN to undertake this activity and hence this task has not yet been initiated.

Seven other *Aquilaria* species are also considered threatened according to the IUCN Red List, five of which are considered to be globally at risk from overexploitation for agarwood: *A. beccariana* (Vulnerable); *A. crassna* (Critically Endangered); *A. cumingiana* (Vulnerable); *A. hirta* (Vulnerable) and *A. microcarpa* (Vulnerable) (Hilton-Taylor, 2002).

Considerable harvest pressure was noted in range States such as Indonesia, Malaysia and Thailand at the time when the species was accepted for inclusion in Appendix II in 1994. *Aquilaria agallocha* is sometimes considered a synonym for *A. malaccensis*, however, this taxonomic distinction relative to CITES trade requires further clarification.

2.3 Population distribution, status, trends and threats by range State

Bangladesh

The agarwood-producing species existing in Bangladesh is recognized by the regulatory authorities of Bangladesh as *Aquilaria agallocha*, rather than *A. malaccensis*, and is found in the eastern hill regions in the divisions of Sylhet, Chittagong, Chittagong Hilltract and Cox's Bazaar. It is not very common in these forests, but no population estimates are available for *A. agallocha* (A. Faruque, Chief Conservator of Forests and Management Authority for CITES, Bangladesh, *in litt.* to TRAFFIC Southeast Asia, April 2003). However, as *A. agallocha* is sometimes considered a synonym of *A. malaccensis*, this taxonomic distinction relative to Bangladesh's trade in agarwood products requires further clarification.

Bhutan

A. malaccensis is found in broadleaf forests in the southern foothills of Bhutan, adjoining the Indian States of Assam and West Bengal (Dr S. Wangchuk, CITES Management Authority of Bhutan, *in litt.* to TRAFFIC Southeast Asia, 2003). Both *A. malaccensis* and *A. khasiana* are native to Bhutan (Kanjilal and Das, 1940, cited in Gupta, 1999; Oldfield *et al.*, 1998). Chamling (1996) noted that although agarwood was still found in Bhutan's forests, it is considerably less abundant than it once was owing to illegal harvest.

Bhutan acceded to CITES in 2002. The CITES Management Authority of Bhutan is unsure of the scale of threat posed to *A. malaccensis* populations in the country's southern border areas due to security concerns making it difficult to collect information from this region. No information is available about its population status or ecology (Dr S. Wangchuk, CITES Management Authority of Bhutan, *in litt.* to TRAFFIC Southeast Asia, 2003). Both legal and illegal harvesting has now severely depleted stands of large Agarwood trees in Bhutan, and high quality resin deposits associated with these older trees must now be assumed to be virtually exhausted. However, government policies giving great importance to nature conservation and active promotion of sustainable development, as well as geographically isolated habitats, are reported to have maintained Bhutan's overall situation in better shape than most other Agarwood-producing countries. This translates into the availability of good and genetically diverse seed sources remaining deep within natural forests. This is important in order to restock the country with *Aquilaria* trees and provide seed sources for Agarwood production (H. Heuveling van Beek, The Rainforest Project Foundation, *in litt.* to TRAFFIC Southeast Asia, August 2003)

Brunei Darussalam

A. malaccensis is not known to occur in Brunei and is not listed in "A Checklist of the Flowering Plants and Gymnosperms of Brunei Darussalam" (Coode *et al.*, 1996). However, Pukul and Ashton(1964, reprinted in 1988) previously reported the existence of the species in Brunei in "A Checklist of Brunei Trees" but the identification was never confirmed – which could be cause for confusion with *Aquilaria beccariana*, which has been confirmed to occur in Brunei. Brunei Darussalam is not therefore not considered further in this report. However, it may be interesting to note that illegal harvest and trade of *A. beccariana* and other *Aquilaria* spp. is known to occur in Brunei's territory, and is monitored by a combination of enforcement agencies (officers from forestry, police, defense, and the judiciary) that detects encroachment and illegal activities (Shahrill Hj. Shahbudin, CITES Scientific Authority of Brunei Darussalam, *in litt.* to TRAFFIC Southeast Asia, 2003).

India

Two species of *Aquilaria* are found in India: *A. khasiana* and *A. malaccensis*, although a third, *A. macrophylla* Miq. (found in the Nicobar Islands) is also thought to produce agarwood (G.S. Giri, Joint Director, Indian Botanic Garden, *in litt.* to TRAFFIC Southeast Asia, 2003). *A. malaccensis* occurs mostly in the foothills of the North-eastern region [Assam, Meghalaya, Nagaland, Mizoram, Manipur, Arunachal Pradesh, Tripura] and West Bengal up to an altitude of 1000 m. In Assam and Meghalaya it occurs sporadically in the district of Sibsagar, Sadiya, Nowgong, Darrang, Goalpara, Garo Hills and Cachar (Atal and Kapoor, 1982). References to *A. malaccensis* in northeast India indicate uncertainty over whether *A. agallocha* is a distinct species or merely a synonym for *A. malaccensis*; this distinction requires a critical study to confirm the taxonomy (G.S. Giri, *in litt.* to TRAFFIC Southeast Asia, May 2003).

A report by Chakrabarty *et al.* (1994) documenting India's trade in agarwood concluded that *A. malaccensis* is highly threatened in that country due to exploitation of the species for commercial purposes. *A. malaccensis* is threatened in its natural habitat because of over-exploitation. In the northeastern region, continued existence of the species in the wild can only be substantiated in Nagaland. No population estimates are available (G.S. Giri, *in litt.* to TRAFFIC Southeast Asia, 2003).

Demand for agarwood has resulted in the unsustainable harvesting of the species, leading to local extinctions. The status of wild *A. malaccensis* has steadily deteriorated with few natural agarwood stocks remaining. According to information gathered by Forest Departments and the Regional Deputy Director of Wildlife Preservation, Eastern region, wild *A. malaccensis* is 'rare' in all of the above-mentioned States (apart from Sikkim and West Bengal where its status was not commented upon) (Gupta, 1999).

Wild agarwood (known locally as 'agar') was heavily extracted from Arunachal Pradesh between the late 1950s and the early 1980s, virtually exhausting the natural stock. Wild *A. malaccensis* is now considered almost extinct in Assam. Surveys undertaken by the Regional CITES Management Authority in Tripura indicate that the natural stock is almost exhausted in that State as well. In Mizoram, the lack of agarwood plantations in Mizoram and Meghalaya has resulted in much illegal harvesting from natural forests. *A. malaccensis* in Nagaland and Manipur is so depleted that a large proportion of the raw agarwood used by processing units in these two States is sourced from neighbouring countries (Gupta, 1999).

Indonesia

A. malaccensis is one of six *Aquilaria* species known to occur in Indonesia, the others being *A. beccariana*, *A. cumingiana*, *A. filaria*, *A. hirta* and *A. microcarpa* (Soehartono, 1997).

A. malaccensis, is known to occur in a scattered pattern in lowland and upland forest areas of Sumatra and Kalimantan (Wiriadinata, 1995). Populations of *A. malaccensis* are depleted in areas of Sumatra such as North Bengkulu, Siberut (Mentawai islands) (Roemantyo, 1992) and East Kalimantan (Sumadiwangsa, 1997). The species is considered virtually extinct in West Kalimantan by Soehartono and Mardiastuti (1997).

Based on field surveys carried out by the Indonesian Institute of Science (LIPI), which serves as the Scientific Authority for Indonesia, with the population density being less than 1 tree/ ha. However, based on an ethno-botanical survey carried out in Ipuh, North Bengkulu (Sumatra), on four observation squares of 0.25 ha each square contained an average of 2 trees (0.31%), 8 "poles" (1.06%) and 11 seedlings (1.38%) of *A. malaccensis* out of a total of 642 trees, 751 poles and 793 seedlings of various tree species per hectare (Roemantyo, 1992). This indicates that in this particular area, *A. malaccensis* was neither abundant nor evenly distributed (CITES Management Authority of Indonesia, *in litt.* to the CITES Secretariat, 2003).

In Kalimantan, four species of *Aquilaria* are found scattered on ridges and slopes of well-drained land (Keller and Sidiyasa, 1994). In 1997, collectors reported that agarwood-producing trees (*Aquilaria* spp.) could be found in several Kalimantan reserves and national parks: Bukit Baka National Park; Gunung Palung National Park; Betun Kerihun Reserve; Mandor Reserve; and Gunung Niut (Soehartono and Mardiastuti, 1997) – however by 2003, habitat in Mandor Reserve is now almost completely depleted due to illegal logging and gold mining activities

(T. Soehartono, in litt. to TRAFFIC Southeast Asia, 2003). Traders confirmed that *Aquilaria* spp. occur in these areas, with the exception of Mandor Reserve, where they are thought extinct. Excessive exploitation has increased the difficulty in finding *Aquilaria* in Gunung Palung and Gunung Niut. In 1997, the National Forestry Inventory (NFI) Database recorded that *Aquilaria* species had adapted to various habitats in certain regions of West Kalimantan. Although widely distributed, the densities of *Aquilaria* were very low. The NFI Database gives approximate population densities of *Aquilaria* species as 1.87/ha in Sumatra and 3.37/ha in Kalimantan (Soehartono and Mardiastuti, 1997). Analysis of 1996 NFI data indicated that the standing stock of *Aquilaria* sp. in Sumatra and Kalimantan numbered more than 10 000 individual trees, acknowledging a considerable margin for error with this estimate (Soehartono and Newton, 2000).

Aquilaria spp. are threatened in Indonesia owing in part to the indiscriminate felling of infected and uninfected trees, which is driven by continuing demand and large profit margins. A number of secondary threats generally applicable to most forest species are also applicable to *A. malaccensis*, e.g. habitat degradation and loss resulting from forest fires, forest conversion to plantations (including forest plantations), logging and land mining concessions, and the creation of settlement areas for transmigratory peoples (Soehartono and Mardiastuti, 1997).

Recent analyses of the ecological impacts of agarwood harvesting suggest that the trade may be having a substantial impact on populations of *Aquilaria* species in Indonesia, with hundreds of thousands of trees having been harvested in the 1990s. As agarwood collectors tend to harvest the majority of trees encountered, those populations subjected to harvesting may have limited ability to recover. It is suggested that agarwood is declining in availability in Indonesia because (i) a majority of collectors report that agarwood is becoming more difficult to find, which implies that stocks are becoming exhausted, at least on a local scale; and (ii) regional trade data indicate a recent decline in the volume of agarwood traded from Kalimantan (which includes *A. malaccensis*), and apparently for the first time, agarwood is being traded in significant quantity from eastern Indonesia (Maluku and Irian Jaya [now known as Papua] provinces). Traders report that this is despite the apparently lower quality of agarwood obtained from the latter source areas (Soehartono and Newton, 2002).

Iran

There is no evidence of *A. malaccensis* occurring in Iran, nor of other agarwood-producing species (CITES Management Authority of Iran, in litt. to TRAFFIC Southeast Asia, June 2003). Iran is therefore not considered further in this report.

Malaysia

A. malaccensis is one of at least four *Aquilaria* species found in Malaysia, the others being *A. hirta*, *A. beccariana* and *A. rostrata*. It is confined mainly to plains, hill slopes and ridges up to 750 m in both primary and secondary Malaysian lowland and hill dipterocarp forests (Jantan, 1990).

A. malaccensis is distributed throughout Peninsular Malaysia, except for the States of Kedah and Perlis (Barden *et al.*, 2000), but although the species has good geographical coverage, its occurrence is rather rare, with trees often locally scattered. La Frankie (1994) studied the population dynamics of *A. malaccensis* in Pasoh Forest Reserve and suggested a typical lowland Malaysian forest density of 2.5/ha and found that the growth rate varied between 0-1.95 cm/year.

There are currently no estimates of population sizes, but the Peninsular Malaysia Forest Department has reported that it will address this lack of information in its Fourth National Forest Inventory which began in 2002. The effect of over-harvesting of adult trees for agarwood on populations is not known. Harvestable sizes may exceed reproductive sizes and further research may enable more effective analysis of reduction in population sizes and population extinctions (L. Chua, Forest Research Institute Malaysia, in litt. to TRAFFIC Southeast Asia, 2003).

In Sarawak, *A. malaccensis* occurs in lowland mixed dipterocarp forest at altitude up to 270 m. It is considered rare, however, no population surveys have been undertaken at the State level for

this species (C.S. Tawan, Universiti Malaysia Sarawak, *in litt.* to TRAFFIC Southeast Asia, 2003).

Based on herbarium specimens held in the state of Sabah, *A. malaccensis* occurs in scattered distributions throughout mixed dipterocarp and submontane forests at altitude up to 800m. No population surveys have been conducted at state level for this species. (Sabah Forestry Department, *in litt.* to TRAFFIC Southeast Asia, 2003).

Malaysia has a long history in the trade in agarwood, which has long been collected by the indigenous peoples of the interior of Peninsular Malaysia, Sarawak and Sabah to supplement their income. In Peninsular Malaysia, the gaharu products in domestic trade are woodchips and powder or sawdust (L. Chua, Forest Research Institute Malaysia, *in litt.* to TRAFFIC Southeast Asia, 2003). Some use has been recorded locally for medicinal purposes, but it appears that the majority of *A. malaccensis* harvested is exported (Barden *et al.* 2000). The wood is also used for making small boxes in Sabah (Sabah Forest Department, *in litt.* to TRAFFIC Southeast Asia, 2003).

In addition to Malaysia's significant exports under legal CITES permits, illegal harvest and trade is known to be a threat to *A. malaccensis*. Encroachment by foreign nationals entering from Thailand to search for agarwood has been noted since 1990 in Peninsular Malaysia, both inside and outside protected areas but has included Taman Negara National Park; Tekal and Tekai Forest Reserve (Pahang State); Endau Rompin National Park (Johor State); Belum National Park and Bintang Hijau Forest Reserve (Perak State) (Abdul Kadir Abu Hashim, Rhino Protection Unit, *in litt.* to TRAFFIC Southeast Asia, 2003). In the late 1990s, Agarwood oil was reported as being distilled illegally in Peninsular Malaysia and this was thought to be undertaken primarily by Cambodians. People from Thailand and Cambodia are also known to enter Malaysia to harvest or purchase agarwood illegally (Dr C.Y. Shyun, Medicinal Plants Division, FRIM, *in litt.* to TRAFFIC International, 2000).

In Sabah, research into gaharu (agarwood) extraction in the Maliau Basin Conservation Area concluded that the activities of gaharu collectors was a major threat to the area, as not only did the collectors cut down potential gaharu-bearing trees, but the expeditions sustained themselves on hunting/trapping while in the forest. Most *Aquilaria* trees found in this area had either already been felled, or had been 'notched' to enhance gaharu production before felling (Sidkan bin Ali, 2001).

In Sarawak, *A. malaccensis* is susceptible to over-exploitation because it occurs in the rich lowland mixed dipterocarp forest, which is exposed to log harvesting and exploitation by local collectors. Indiscriminate harvesting also leads to trees being felled and therefore, fewer seeds and seedlings are available for regeneration (C.S. Tawan, Universiti Malaysia Sarawak, *in litt.* to TRAFFIC Southeast Asia, 2003).

Myanmar

A. malaccensis (synonymous with *A. agallocha* in Myanmar forestry literature) is mainly found in evergreen forest and rainforest areas of southern Myanmar such as Tanintharyi (formerly Tennasserim) and Myeik (formerly Mergui), and in areas of northern Myanmar, such as Sagaing, Chin, Shan and Kachin. There is no current field survey data upon which to base population estimates of *A. malaccensis* at the local or national level, but inventories conducted from 1981-1998 in six administrative regions indicated that Rakhine State Shan State and Kachin State held the highest number of *Aquilaria* trees. There is some extraction of *A. malaccensis* for local use in traditional medicines, including those used by Myanmar's ethnic Chinese population. (U Khin Maung Zaw, CITES Scientific Authority of Myanmar *in litt.* to TRAFFIC Southeast Asia, 2003).

Philippines

There is no data available for *A. malaccensis* (Manuel V.A. Bravo, Ecosystems Research and Development Bureau, Philippines, *in litt.* to TRAFFIC Southeast Asia, 2003). However, information obtained from the CITES Management Authority several years previously stated that the species was considered very rare in the Philippines and was once found in the Camarines Province (CITES Management Authority of the Philippines, *in litt.* to CITES Secretariat, 1999).

Singapore

A. malaccensis and *A. hirta* are found in Singapore, mainly occurring in the lowland forest. The population status of *A. malaccensis* is not known, but it is listed as Rare in Singapore's Red Data Book on Threatened Plants (CITES Management Authority, Singapore, *in litt.* to TRAFFIC Southeast Asia, 2003).

Thailand

A. malaccensis is found in southern Thailand in Chumphon, Ranong, Krabi, Patalung, Trang and Yala provinces, while *A. crassna* is found in the central, northern and north-eastern part of the country. All species of *Aquilaria* are distributed within protected areas (Surakai Sangkasubuan, Plant Varieties Protection Office, Thailand Department of Agriculture, *in litt.* to TRAFFIC Southeast Asia, 2003). No information regarding the species' population status is available (Surakai Sangkasubuan, *in litt.* to TRAFFIC Southeast Asia, 2003). Illegal harvest from forested areas continues to threaten *A. malaccensis* in southern Thailand, with heavy extraction noted from the areas of Songkhla, Trang, Yala and Narathiwat (A. J. Lynam, Wildlife Conservation Society Thailand, *in litt.* to TRAFFIC Southeast Asia, 2003).

3. Conservation and management

(Habitat protection, Regulation of wild harvesting, Regulation of trade, Monitoring, Basis of non-detriment findings)

Bangladesh

No legislative provisions have been enacted for the regulation of harvesting and trade of *Aquilaria* spp., and no exports have been recorded (A. Faruque, *in litt.* to TRAFFIC Southeast Asia, 2003). It is not known whether there are any measures to protect the habitat of the species.

Bhutan

A. malaccensis is a totally protected species in Bhutan, listed under Schedule I of the Forest and Nature Conservation Act of 1995. No exports have been recorded from Bhutan (Dr Sangay Wangchuk, *in litt.* to TRAFFIC Southeast Asia, 2003).

India

Individual States within India have established various harvest control measures, including complete bans on harvests, harvests allowed under lease (*Agar Mahi*) and harvests restricted to private lands. Prior to the species being listed in CITES Appendix II, it was legal to extract *A. malaccensis* from most States. Harvesting from Arunachal Pradesh, Assam and Meghalaya is now prohibited by State bans (under the *Indian Forest Act* (1927), which also protects some critical *A. malaccensis* habitats as Reserved Forests), while harvesting in Manipur is restricted by an administrative order. In Tripura, harvesting from government lands has been prohibited since 1994. Mizoram and Nagaland leased out harvesting privileges from 1990 to 1993 and from 1991 to 1992, respectively; and as of 1999 it was unknown whether lease terms had been renewed (Chakrabarty *et al.*, 1994; Gupta, 1999).

The *Indian Forest Act, 1927* regulates domestic harvests and both the intra- and inter-State transport of agarwood. Controls are implemented through a permit system that is managed by the Department of Forestry. Divisional Forest Offices maintain records of licences and permits issued to harvest agarwood from plantations; only a few individuals had obtained such permits in the late 1990s. These individuals obtain separate permits to harvest and transport agarwood as and when the opportunity arises rather than setting up registered companies (S.K. Das, pers. comm. to TRAFFIC India, 1999).

In Tripura, landowners can harvest stock from their private plantations if they obtain a Harvest Permit issued by the Forestry Department. Such landowners can then apply, again to the Forestry Department, for a Transit Pass (TP) enabling them to transport their stock to a 'safer place' within Tripura.

In Manipur, a TP is issued for agarwood harvested from the East Garo Hills (Meghalaya) by the Williamnager Range Forest Officer. In Assam, Lieu Transit Passes (LTPs) are issued by the Assam

Forest Department to those who have legally transported agarwood from neighboring States (primarily Manipur, Mizoram and Nagaland). LTPs are issued upon the presentation of a valid TP issued in another State. LTPs allow the transportation of agarwood to any destination within Assam. Processing units in Assam are required to be licensed by the Industry Department. The Industry Department does not liaise with the Forest Department regarding the availability and source of raw agarwood and it is not mandatory for processing units to declare their source of raw supply. The Forest Department of Tripura has the authority to issue licenses enabling the establishment of processing units. Although many traders have approached the Forest Department in this regard, all applications have been rejected, principally due to the lack of a regular source of raw agarwood.

The Forest Department is responsible for domestic seizures, while Customs authorities and the Border Security Force are responsible for seizures at borders and airports. In most cases, Customs and the Border Security Force turn over seized consignments to Forest Department officials for prosecution under the *Indian Forest Act*. Cases are referred to either the Court of Sub-divisional Judicial Magistrate or are adjudicated departmentally through the Forest Department. Departmental adjudication is typically used to penalize offenders with no previous history of forestry-related offences. A fixed compensation fee and a fine of at least twice the current market value of the seized consignment is imposed. If found guilty, offenders are subjected to a fine and/or imprisonment (Gupta, 1999).

The export of *A. malaccensis* was prohibited in 1991, when the export of all wood products (including logs, timber, chips, powder, flakes, dust etc.) of all *Aquilaria* species was banned through the EXIM policy in force at that time. The EXIM policy of 1993-2002 permitted the import of *A. malaccensis* (including chips, dust and oil), but maintained the 1991 blanket export ban on Indian-harvested specimens. This policy has continued in the EXIM policy of 2003-07, backed by the specific regulation of *A. malaccensis* exports under the Negative List of Export of Plants. The Negative List of Export of Plants specifically prohibits the export of 29 native flora species, including *A. malaccensis*. This includes the plants, plant portions, derivatives and extracts obtained from the wild (M.K. Misra, Director PEACE Institute, *in litt.* to TRAFFIC Southeast Asia, 2003).

There are exceptions to the export ban, however, which allow the export of native species included in the Negative List. These include formulations, which are defined as products containing plant portions or extracts in unrecognizable and physically inseparable forms. Native wild *A. malaccensis* can therefore be freely exported in forms such as oil or medicine. Also, the export of Indian 'cultivated' varieties (i.e. agarwood derived from plantations) is permitted when accompanied by a Certificate of Cultivation. This is obtained from the Regional Deputy Director of Wildlife (CITES Management Authority), or the Chief Conservator of Forests or Divisional Forest Officers, in the State where the material was procured. A CITES export permit is also required.

Imported agarwood may be re-exported as value-added herbal formulations, if these are manufactured only from imported material. At the time of export, exporters are required to present an affidavit to Customs authorities stating that only imported plant material was used to produce the formulation being re-exported.

Random sample tests are undertaken to verify the authenticity of affidavits, with action taken under the *Foreign Trade (Development and Regulation) Act 1992* against false affidavits. When export is allowed under the above conditions, it must occur only through the ports of Amritsar, Calcutta, Chennai, Delhi, Mumbai and Tuticorin (Gupta, 1999).

As the export of native populations of agarwood is banned under the current EXIM policy, it is assumed that no non-detriment finding methodology is in use and there was no specific information given by the Indian CITES Authorities in the questionnaire response for this review. However, the export of oil is permitted (and limited exports of oil and extract of wild origin are detailed in CITES data for 1999 and 2000), and the scientific basis for permitting these exports is unknown.

Indonesia

The use of agarwood is regulated via *Decree No. 8* of 1999 concerning the *Uses of Wild Flora and Animals*. *A. malaccensis* is not included in the central government's list of protected fauna and flora (*Decree No. 7* of 1999). Agarwood is considered a forest product and therefore control of harvest and domestic transport is the responsibility of the Ministry of Forestry and Regional Forestry Offices. Permits are required to harvest *gaharu* (including *A. malaccensis*) from State forests, as set out in

Forestry Regulation No. 28 of 1985. An exception is made for local communities dependent on forest resources for their livelihoods (Soehartono and Mardiastuti, 1997).

Local forest authorities at each *kabupaten* (district) are entrusted to administer permits for all activities within their own forest authority. Large collecting groups of 20-30 people are said usually to obtain harvesting permits from the local forest authority to harvest from natural forests. Registered traders are thought almost certainly to obtain permits to avoid unnecessary difficulties when shipping consignments to other islands. However, smaller groups of two to four collectors are said to obtain harvesting permits rarely, owing to the small likelihood of being caught by forest authorities. Obtaining a permit is said to be a lengthy process (taking up to one day) and is considered inconvenient by the collectors unless they reside close to the local authority office from which the permit must be obtained (Oetomo, 1995; Soehartono and Mardiastuti, 1997).

Before agarwood consignments are shipped to other regions within Indonesia, traders are required to pay a forest resource tax known as the Iuran Hasil Hutan (IHH), which varies according to the weight and grade of the consignment (Oetomo, 1995). The fees are IDR 20 000/kg (USD 2.5/kg) for both *Damar gaharu* (resin) and *Gubal gaharu* (inner part of agarwood), and IDR 15 000/kg (USD 2/kg) for *Kemedangan gaharu* (*Decree of Minister of Forestry No.606/Kpts-IV/1996*). Traders are also required to obtain a wood transport permit known as a *Surat Angkutan Kayu Olahan* (SAKO) (from the local forest authority in order to transport agarwood to another region).

Under the auspices of the Ministry of Forestry, the Directorate General of Forest Protection and Nature Conservation (PHKA) is Indonesia's CITES Management Authority. Agarwood exporters must be licensed and registered with PHKA in order to apply for CITES export permits. To obtain a trading license, companies must already have acquired several documents including a Business Permit and a Certificate of Inspection and to have been recommended for licensing by the Regional Forestry Office. In the early 1990s, three companies were registered in West Kalimantan, but by 1997 only one company was operating (Soehartono and Mardiastuti, 1997). This company had links to 14 middlemen throughout the region. Thirty registered companies were in operation in Irian Jaya during the period 1994 to 1995 (Anon., 1995), but this had fallen by half in 1997 (Anon., 1997a). In Nusa Tenggara Barat, there is reportedly only one company in operation (Anon., 1997b). As of March 2003, there were 16 exporters registered as gaharu (agarwood) exporting companies by the CITES Management Authority. All are members of a single association, the Asosiasi Pengusaha Exportir Gaharu Indonesia (ASGARIN).

According to Soehartono (1997) and subsequent information received from the CITES Authorities of Indonesia (*in litt.* to TRAFFIC Southeast Asia, May 2003), annual harvest quotas began to be established for *A. malaccensis* following the species' listing in CITES Appendix II. The harvest quota is distributed among Regional Forest Offices located in regions having the potential to produce agarwood, who in turn distribute the quota among registered agarwood traders.

PHKA (formerly known as PKA, and prior to that, PHPA) began issuing total annual harvest and export quotas for *Aquilaria malaccensis* in 1996 (see Table 3). Quota levels are determined by PHKA in consultation with LIPI. Data provided by each Regional Forestry Office (*Kanwil*) are reported to be taken into account (Priyadi, 1999). As mentioned above, population data for *A. malaccensis* and other *Aquilaria* species are lacking (Oetomo, 1995).

Ministry of Forestry staff inspects both imports and exports. Although they check, for example, permit validity and that the permit volume tallies with the actual trade volume, they have acknowledged that few officers can actually differentiate between *A. malaccensis* and other *Aquilaria* species (P. Subijanto, PKA, pers. comm. to TRAFFIC Southeast Asia, 21 April 1999). Noting that government authorities were not yet able to identify agarwood products in trade (normally chips and powder) to species level, Soehartono (1997) comments that, in practice, CITES regulations and procedures are applied to the export of any agarwood products, regardless of the species involved. Therefore, it is likely that CITES export permits are likely to be issued for other *Aquilaria* species in addition to *A. malaccensis*.

Monitoring: The extent of current monitoring, beyond the collection of transport permits described above, is unknown. However, the Indonesian CITES authorities believe that monitoring and control can be assisted by ASGARIN, which was initially established to assist the government in monitoring trade. Now, the role of the trade association has expanded to include in assisting the Scientific

Authority in undertaking population monitoring or field surveys (CITES Scientific Authority of Indonesia, *in litt.* to TRAFFIC Southeast Asia, 30 April 2003).

Basis for making non-detriment findings: Soehartono and Newton (2000) state that data on the population size of *Aquilaria* spp. is only available for very limited and localized areas in Bengulu (Sumatra) (Misran, 1987; Roemantyo, 1992) and South Kalimantan (Sidiyasa et al., 1986), and that the setting of quotas for volumes of agarwood traded legally under CITES can therefore only be based on broad estimations – thus running the risk of negatively affecting the conservation status of the species.

According to Irawati and Wiriadinata (*in litt.* to TRAFFIC Southeast Asia, 2003), the non-detriment finding for *A. malaccensis* shows that biological management and control aspects for this species cannot support the same quota volumes as in previous years. Quotas are set by the Government of Indonesia in order to implement Article IV of CITES concerning non-detrimental trade to wild populations. This approach is applied to all Appendix II-listed species that are harvested and exported, for which population data on a national scale is lacking.

Quota levels are set by the individual Management Authority officers in each province by field visits to where the harvesting takes place. Harvest quotas are based on a range of available data, including information on the biology and distribution of the species, general land-use and potential threats in specific areas. Draft quota volumes are then reviewed and assessed further by the CITES Scientific Authority. When setting the quotas, the Scientific Authority may seek advice from a wide range of experts, including scientists from other research organizations, universities and NGOs. Once quotas are finalized, the CITES Scientific Authority will submit them back to the Directorate General of Forest Protection and Nature Conservation (CITES Management Authority) which then issues an annual decree on the national allowable harvest (Irawati and Wiriadinata, *in litt.* to TRAFFIC Southeast Asia, 2003).

In the context of the CITES listing of *A. malaccensis* and its sustainable use, the key issue is the impact that agarwood harvesting is having on population numbers (Soehartono and Newton, 2000). This requires the number of trees felled during harvesting to be estimated and compared with the estimates of total population size, like those held at the National Forest Inventory (Soehartono and Newton, 2000). In the absence of population data, and the merging of additional species with the *A. malaccensis* quota, the effectiveness of the quota setting is unclear, as it does not allow for the management of harvest or export at species level.

Malaysia

The government of each of Malaysia's three administrative jurisdictions requires that permits be obtained from the relevant State Forestry Department to harvest and trade all agarwood-producing species. Harvesting from national parks or wildlife sanctuaries is prohibited in all States.

Within Peninsular Malaysia, the *National Forestry Act, 1984* prohibits the felling of *Aquilaria malaccensis* from State forests or Permanent Forest Estates. Harvesting from national parks or wildlife sanctuaries is prohibited by the *Protection of Wildlife Act, 1972*. Under the *National Forestry Act*, illegal removal of forest products is subject to fines of up to MYR2000 (USD526) and/or imprisonment up to 12 months. A 'Removal of Minor Forest Product' permit is required to harvest all *Aquilaria* spp. from Peninsular Malaysia. Permits cost MYR100 (USD26) and are renewable annually. Additionally, collectors are charged a premium fee that varies with each State. For example, in Perak (Peninsular Malaysia) the collector's fee is MYR100/200/ha (USD26/200/ha) and an additional royalty fee of MYR18/t (USD5/t) applies to all *Aquilaria* spp. (E.N.M. Shah, State Deputy Director, Department of Forestry, Perak, pers. comm. to TRAFFIC Southeast Asia, April 1999).

In Sarawak, *A. malaccensis* (as well as *A. beccariana* and *A. microcarpa*) is protected under the *Wildlife Protection Ordinance, 1998* (C.S. Tawan, *in litt.* to TRAFFIC Southeast Asia, 2003). Harvesting from national parks or wildlife sanctuaries is prohibited by the *National Parks and Reserves Ordinance, 1998* and the *Wildlife Protection Ordinance, 1998*, unless a license has been issued by the Sarawak Forest Department to harvest, sell or export the species. Illegal removal of Sarawak's protected plants can result in imprisonment of up to 12 months or fines of MYR 10 000 (USD 2631) (A.B. Othman, Director Crop Protection and Plant Quarantine Services Division, Department of Agriculture, Malaysia, *in litt.* to CITES Secretariat, 22 January 2000).

No management program has been initiated by the Forest Department or any other agency. No export quotas have been established, but Sarawak is gradually reducing the export of *Aquilaria* spp. and at the same time, reducing harvest from the wild (C.S. Tawan, *in litt.* to TRAFFIC Southeast Asia, 5 June 2003).

In Sabah, felling of *Aquilaria malaccensis* is subject to the *Forest Enactment, 1968*, whilst harvesting from State land (government forests and gazetted parks and their equivalents) is forbidden by the *Parks Enactment Act, 1984*. Convictions for illegally harvesting any forest materials in Sabah will result in fines of up to 10 times the royalty value. Illegal exporters are subject to fines not exceeding MYR 500 000 (USD131 555) or imprisonment under the *Forest Enactment* and *C.F. Circular 1/83*. For more general offences such as the altering and counterfeiting of documents and permits relating to the provisions of the *Forest Enactment*, the fine is MYR5000 (USD1316). Under the *Wildlife Conservation Enactment, 1997*, the searching for and the harvesting of all CITES-listed plants requires a Plant Collection Licence issued by the Director of the Sabah Wildlife Department. Offences made against the *Wildlife Conservation Enactment* incur a fine of MYR30 000 (USD7893) and/or imprisonment up to three years (Barden *et al*, 2000).

Monitoring: Up until 2000, no seizures of *Aquilaria malaccensis* were known to have been reported, which may reflect, at least in part, the difficulties involved in distinguishing *A. malaccensis* from Malaysia's other native *Aquilaria* species (Barden *et al*, 2000). No further information is available regarding seizures of illegally harvested agarwood from questionnaire responses submitted by Peninsular Malaysia, Sabah or Sarawak for this review. In all three administrative jurisdictions of Malaysia, the use of harvest and/or export quotas and any potential processes for monitoring extraction of agarwood are unknown.

Basis of Non-detriment Findings: In Peninsular Malaysia, there is no non-detriment finding methodology in use (L. Chua, Forestry Research Institute of Malaysia, *in litt.* to TRAFFIC Southeast Asia, 2003). In Sarawak, there is no non-detriment finding research currently being conducted (C.S. Tawan, Universiti Malaysia Sarawak, *in litt.* to TRAFFIC Southeast Asia, 5 June 2003). In Sabah, the basis for non-detriment findings is unknown, but the neither is this jurisdiction reporting any exports.

Myanmar

Although Myanmar's forest management procedures are mainly focused on Teak *Tectona grandis*, other species are also managed following Forest Department procedures described under Myanmar's Forest Law (1992). *A. malaccensis* is defined as a 'minor forest product' under this legislation, but because *A. malaccensis* is also listed as a protected tree species, it is not allowed to be harvested. Permission to establish plantations may be applied for through the Forest Department (U Khin Maung Zaw, *in litt.* to TRAFFIC Southeast Asia, 2003).

Philippines

Trade in CITES-listed species such as *A. malaccensis* are regulated by Wildlife Resources Conservation Act (RA 9147), the NIPAS Law (RA 7586), and the Forestry Code (PD 705, PD 1559 Amended) (Manuel V.A. Bravo, *in litt.* to TRAFFIC Southeast Asia, 2003).

Singapore

The harvest of *A. malaccensis* is not allowed, as the species is protected under the Singapore National Parks Act (CITES Management Authority of Singapore, *in litt.* to TRAFFIC Southeast Asia, 2003).

Thailand

All species of *Aquilaria* are distributed within protected areas. Domestic trade, harvest for trade and manufacture are prohibited except with permission (Surakai Sangkasubuan, Thailand Department of Agriculture, *in litt.* to TRAFFIC Southeast Asia, May 2003). CITES provisions for *A. malaccensis* are implemented by the Plants Act, B.E. 2535 of 1992, which prohibits the import, export and transhipment of all CITES-listed plants, except with the permission of the Agriculture Director-General. A 'conserved plant', as covered by the Plants Act, includes all CITES-listed plants and those announced by the Minister in a Ministerial Notification. Exceptions to the Act are controlled seeds, prohibited

plants and reserved plants. The Plants Act regulates the artificial propagation of CITES-listed plants through a nursery registration system. Violation of this Act would result in a fine of up to THB3000 (USD74) and/or imprisonment of up to three months (Barden *et al.*, 2000).

The Government of Thailand has not issued any CITES export permits since the end of 1997 because *A. malaccensis* is regarded as threatened in the country (CITES Scientific Authority of Thailand, statement made at the Ninth Meeting of the CITES Plants Committee, Australia, June 1999). UNEP-WCMC data show Thailand has not reported any exports of *A. malaccensis* since 1997, however it is unknown what – if any - non-detriment findings were applied to those exports that occurred in the period 1995-97.

4. Overview of trade

The first known account of international trade in agarwood was compiled by a Chinese customs official in 1200 A.D., and shows agarwood to have been supplied to China from Borneo, Sumatra, Java, the Malay Peninsula and Cambodia (Chakrabarty *et al.*, 1994). Agarwood from *Aquilaria* species, including *A. malaccensis*, is traded under several names including agar, aloeswood, eaglewood, *gaharu* and *kalamabak*. The variety of trade names increases the difficulty of trade monitoring. Agarwood is mainly traded as wood, wood chips, powder and oil, although roots are also known to be traded. Although not strictly identified in CITES trade data, finished products such as perfumes, incense and medicines are also traded internationally (and domestically) which may account for the references in CITES data to trade reported using the terms derivatives and extract, especially as some of these are reported using the units 'bottles' and 'cartons'. Since 1997, harvest and trade sources for the global agarwood market (all species), while continuing to include the traditional supply states of India, mainland Southeast Asia, and the islands of Sumatra and Borneo, has been characterized by large volumes being extracted from eastern Indonesia and the island of New Guinea. Initially this took the form of *Aquilaria filaria* from Maluku and Papua (formerly Irian Jaya) provinces but since 1999, Papua New Guinea has begun reporting agarwood exports sourced from *Gyrinops ledermannii* to Singapore (Zich and Compton, 2001).

UNEP-WCMC CITES data shows that the major proportion (over 95%) of *A. malaccensis* in trade is sourced from Indonesia and Malaysia. However, Singapore plays a major role as an entrepot, re-exporting Indonesian and Malaysian agarwood to a variety of final destination markets, namely Taiwan (Province of China), UAE, Saudi Arabia and Japan. Hong Kong S.A.R. also plays a role as a re-exporter and end-consumer, and India, historically a supplier of native *A. malaccensis* to the end-use markets of the Middle East, is now re-exporting specimens sourced from elsewhere and presumably some imports go towards satisfying its own domestic market. Taiwan (Province of China) remains the single most important end-consumer, although reported exports of *A. malaccensis* to that country have decreased since 1998. Middle Eastern markets, most significantly UAE and Saudi Arabia, remain centers of high demand, with both countries surpassing Taiwan (Province of China) in importance after 1998, while Japan has imported a consistent annual amount of *A. malaccensis* (ranging from 11 t to 22 t per year) between 1995-2001. Customs data from Taiwan (Province of China) show much larger volumes of imports of all *Aquilaria* spp., and while Indonesia remains the primary source of supply, Viet Nam, Thailand and Cambodia rank higher in terms of total volume than Malaysia, which is only the fifth-largest supplier of agarwood (all species) to Taiwan (Province of China) over the period 1993-2002.

Agarwood is not a uniform product, but instead possesses different characteristics. It is classified according to various grading systems that differ according to the product in trade and country in which trade is taking place. The grade (and hence value) of agarwood and agarwood derivatives such as oil is determined by a complex set of factors including: country of origin; fragrance strength and longevity; wood density; product purity; resin content; color; and size of the form traded (Barden *et al.*, 2000).

The type and number of agarwood grades used within a given country may vary widely. One large dealer in Singapore, for example, usually offers flakes or chips from five or six countries, with the agarwood from each country being divided into three to five grades (Heuveling van Beek and Phillips, 1999). The chemical components of different grades have been studied (Ishihara *et al.*, 1991, cited in Ng *et al.*, 1997). Yoneda *et al.* (1984, cited in Ng *et al.*, 1997) suggested that the chemical profile of agarwood varies according to species. Whether or not this is the case, it is primarily the country of origin and quality of wood, and not necessarily the species from which agarwood is derived, that is of greatest importance to consumers and hence traders.

Heuveling van Beek and Phillips (1999) have observed that consumers in different countries have different priorities for assessing the qualities of agarwood, which relate to its intended use. Customers from the Middle East consider fragrance to be the most important quality and in India a significant quantity of agarwood oil is used for perfumery, hence odor quality is of prime importance. Consumers from Taiwan (Province of China) buy substantial quantities of agarwood for medicinal purposes and in such cases it is not the fragrance of agarwood but the quantity and composition of resinous material in the wood that is of greatest importance (Heuveling van Beek and Phillips, 1999). Consumers and traders in Taiwan (Province of China) believe that the highest qualities of agarwood are sourced from Sumatra, Borneo and from some other islands in the Malay Archipelago (TRAFFIC East Asia-Taipei *in litt.* to TRAFFIC International, 2 May 2000).

The most common form of *A. malaccensis* in trade is wood chips (chips), followed by powder and timber. Agarwood oil nominally derived from *A. malaccensis* appears in CITES annual report data only sporadically.

If seizures or confiscations of *A. malaccensis* are occurring at the point of (re-) export or import, these are not being reported in CITES annual reports. The only specimens reported in CITES data with the source code "I" (i.e. seized or confiscated specimens) are reported to be 'traded' for enforcement or educational purposes. These are 13 kg of chips re-exported from Hong Kong to China in 2000, 2 units of derivatives between the Czech Republic and the Netherlands in 2001, and two dried plants re-exported by the Netherlands to the Czech Republic in 2001. Although there is little reported evidence of illegal international trade, reports of illegal or unreported harvesting in range States such as Indonesia, Malaysia, Myanmar and Thailand which do not have substantial domestic markets would indicate that illegal international trade of an unknown volume has occurred.

Table 1: *Aquilaria malaccensis* imports and exports (kg) from range States as reported in CITES annual reports compiled by UNEP-WCMC from 1995 to 2001 (excluding re-exports)

Range State	Year	Imports reported from range States	Exports reported by range States
Indonesia	1995	500	323,577
	1996	21,4922	293,593
	1997	1 783	305,483
	1998	247	147,212
	1999	0	76,401
	2000	0	81,377
	2001	4,772	74,826
Malaysia	1995	116,411	90,478
	1996	157,713	163,107
	1997	90,830	87,230
	1998	60,050	630,851
	1999	35,270	528,190
	2000	65,500	887,600
	2001	21,300	32,900
Thailand	1997	216	244
India	1999	0	5
	2000	5,600	3
	2001	0	1

Source: CITES annual report data compiled by UNEP-WCMC

Table 2: Trade in *Aquilaria malaccensis* (kg) by country of import

Country	Year	Chips, powder and timber		Oil	
		Imports reported by country of import	Exports/re-exports to country of import reported by country of export/re-export	Import reported by country of import	Exports/re-exports to country of import reported by country of export/re-export
United Arab Emirates	1995		51,256		2
	1996		25,388		
	1997		52 ,429		
	1998		82 ,668		
	1999		26 ,042		
	2000		21 ,305		
	2001		10 ,303		
Hong Kong	1995	25 ,855	40 ,275		
	1996	47 256	57 ,357		
	1997	52 684	52 770		
	1998	55 093	55 487		
	1999	63 354	66 576		
	2000	27 769	27 770		
	2001	15 787	22 973		
India	1995	38	14 454		
	1996		15 184		
	1997		19 364		
	1998		36 867		
	1999	6 699	45 150		
	2000	24 399	37 018		
	2001	42 833	69 847		
Japan	1995	6 629	11 159		
	1996	10 829	22 302		
	1997	10 134	20 512		
	1998	8 126	18 082		
	1999		21 119		
	2000		21 175		
	2001		20 202		
Saudi Arabia	1995		39 885		377
	1996		13 307		
	1997		75 392		2
	1998		73 168		
	1999		21 616		
	2000		15 674		
Singapore	1995	116 581	345 677		
	1996	375 882	417 130		
	1997	91 046	350 158		
	1998	33 550	173 733		
	1999	5 000	79 952		
	2000	70 950	127 899		
	2001	21 300	90,265		

Taiwan (Province of China)	1995		211 308		1
	1996		69 756		
	1997		121 302		
	1998		38 798		
	1999		13 951		
	2000		6 139		
	2001		45 077		

Source: CITES annual report data compiled by UNEP-WCMC (excluding entries under *Aquilaria* spp.)

Bangladesh

There is no recorded export of *A. agallocha* from Bangladesh (Anwar Faruque, CITES Management Authority of Bangladesh, *in litt* to TRAFFIC Southeast Asia, 2003). Bangladesh appears as an importer of *A. malaccensis* in CITES data, importing a total of 10 112 kg from Singapore between 1995 and 2001.

Bhutan

Research conducted on the agarwood trade in neighboring India indicates that Bhutanese agarwood is considered to be of high quality. One agarwood dealer based in Dubai, interviewed in Mumbai (India) in the late 1990s, considered that, of all range States for *A. malaccensis*, Bhutan was the source of the best-quality agarwood. However, supplies are restricted owing to the strict control over forest access and harvest and a ban on exports since 1991 (Barden et al., 2000). Bhutan has not reported any exports of *A. malaccensis* from its territory, neither any imports. No exports are recorded to Bhutan.

India

International Trade: Records of trade in *A. malaccensis* included in India's CITES annual reports for the period 1995 to 1997 are limited to the import of 38 kg of *A. malaccensis* in 1995. However, CITES annual report data provided by Singapore indicate that far larger quantities of *A. malaccensis* have been re-exported to India. Approximately 14 t of chips in 1995, 15 t of chips and powder in 1996 and 19 t of chips and powder in 1997 were reported by Singapore as re-exported to India. These data are corroborated by trade data provided by India's Directorate General of Commercial Intelligence and Statistics, Calcutta, which show the import of 12 t of agarwood chips and dust from 1995 to 1996 and 24 t from 1996 to 1997. Data from the same source show the export from India of over 18 t of agarwood chips and dust from 1995 to 1996, and of nearly 20 t from 1996 to 1997. Since 1998, records from India's annual reports show India's trade in *A. malaccensis* included incidents of import, export and re-export, with an emphasis on the latter.

During the period 1998-2001, India reported imports of 74 t of chips and powder, mostly via Singapore and Hong Kong, of agarwood originating in Malaysia and Indonesia. During 1998-2001, Singapore's annual reports show that 182 t of chips and powder were re-exported to India from sources originating in Malaysia and Indonesia. In the same period, Singapore reported imports from India 5.6 t of powder in 2000.

In 1998, India reported re-exports of 1,681 kg to the UAE, noting the country of origin as Indonesia. In 1999, India reported exports of 3,027 kg, all of which were again re-exports of agarwood of Indonesian origin to the UAE, except 5 kg that were exported to the Netherlands. In 2000, India reported re-exports of 11,620 kg to the UAE of agarwood originating in Malaysia, and minor exports of 2.78 kg to Australia and New Zealand. In 2001, India reported 3,833 kg of re-exports to the UAE of agarwood originating in Malaysia, and 6,615 kg of re-exports to Singapore of agarwood originating in Malaysia.

Domestic Trade: India's agarwood industry relies primarily on imports from Singapore (the agarwood originating in Indonesia and Malaysia, according to Singapore's CITES annual reports) and, according

to information collected from traders, from the neighboring *A. malaccensis* range States of Bangladesh, Bhutan and Myanmar, as well as from Cambodia, Lao PDR, Thailand and Viet Nam. Agents based in southeast Asian countries are reported to dispatch agarwood supplies to Mumbai periodically, usually accompanied by an agent. Some overseas suppliers are also said to be involved in supplying agarwood to traders and processors in India via air. There are no reports of suppliers based overseas flying agarwood out of India, although there are reports of Indian-based traders exporting agarwood this way (Gupta, 1999).

The agarwood markets of Mumbai are mainly supplied by middlemen who have brought agarwood, mostly in the form of oil, but also as chips, from Assam. Some of the traders interviewed recounted importing and exporting agarwood via Mumbai. The locations of traditional perfume shops in Mumbai are strategically placed near hotels popular with visitors from the Middle East, the primary purchasers of agarwood perfumes, chips and oil. Traders are also reported to operate from other northeastern towns such as Agartala, Imphal, Jorhat, Sibsagar and Silchar. The methods of agarwood shipment include by post (in parcels weighing less than 10 kg), by rail, either accompanied or unaccompanied, and occasionally by road (Gupta, 1999).

According to Heuveling van Beek and Phillips (1999), Indian importers buy many tonnes of grade 5 or 6 agarwood powder for distillation purposes. Many large processing units are located in Assam. Chakrabarty *et al.* (1994) reported that a total of approximately 200 agarwood oil distilleries operated in the towns of Hojai, Islamanager and Nilbagan in Naogaon district in 1993. The number of distilleries in current operation is unknown, but interviews conducted in the late 1990s suggested that there were far more processing units in Assam than in 1993. Unconfirmed local enquiries suggest that there may be more than 1500 processing units in Hojai alone, although, according to available information, the Industry Department has issued licenses to only 29 (unlicensed processing units are presumably operating illegally).

Surveys in the late 1990s indicated that oil distillation was also undertaken in Calcutta and that raw agarwood is processed into chips in Mumbai. Processing units were also found in the States of Tripura, Arunachal Pradesh, Mizoram, Nagaland and Manipur, the latter two alleged to be supplied primarily by smuggled stock from Myanmar and Bangladesh. Traders reported that agarwood is also processed into chips in Dubai by Indian laborers employed there.

In the late 1990s, wholesale agarwood prices were fixed by certain forest divisions in the northeast. The Forest Department collected and reviewed existing market prices for the various grades of agarwood from different Divisional Forest Officers to decide the price. The Principal Chief Conservator of Forests then approved these prices (Gupta, 1999).

Indonesia

Indonesia's annual harvest and export quotas for *A. malaccensis* (e.g. 50,000 kg in 2003) nominally include the additional species *A. beccariana*, *A. hirta*, *A. microcarpa* and *Gyrinops versteegii* (CITES Management Authority of Indonesia, *in litt.* to TRAFFIC Southeast Asia, 2003). There is some question over whether *A. hirta* is in fact now extinct in the Indonesian part of its range (T. Soehartono, *in litt.* to TRAFFIC Southeast Asia, December 2003). The inclusion of these additional species has also been the case in *A. malaccensis* quotas since 2000. It is therefore impossible to determine exactly how much actual *A. malaccensis* is being harvested and exported from Indonesia.

Table 3: Harvest and Export of *Aquilaria* spp. from Indonesia 1995-2001

Year	Official Harvest Quota *	Actual Harvest Quota *	Actual Export by Indonesian CITES Permit records*	Reported CITES Net Exports**	Total Agarwood (gaharu) exports (all species) from Indonesia *
1995	n/a	n/a	n/a#	323,577	n/a#
1996	300,000	160,000	299,523 (included 140,000 kg of <i>A. filaria</i> and other species)	293,593	299,523
1997	300,000	120,000	287 002 (included 180,000kg of <i>A. filaria</i>)	305,483	287,002
1998	150,000	150,000	148 238	147,212	n/a#
1999	300,000	180,000	81 079	76,401	313,649
2000	225,000	225,000	81 377	81,377	245,150
2001	75,000	70,000	74 826	74,826	219,772
2002	75,000	68,000	70 546	n/a	175,245
2003	50,000	50,000	n/a	n/a	n/a

Sources:

* CITES Management Authority of Indonesia

** CITES annual report data compiled by UNEP-WCMC

the reason for the unavailability of data for 1995 and 1998 is not known

Between 1996 and 2002, records of actual exports designated as *A. malaccensis* (but considering the quota system, this includes agarwood from several other agarwood-producing species) from Indonesia totaled approximately 1,042,591 kg [approx 1043 t] (CITES Management Authority of Indonesia, *in litt.* to the CITES Secretariat, 2003). However, UNEP-WCMC data records show that during the period 1995-2001, Indonesia reported 1,302,469 kg [approx 1302 t] under CITES permits.

Singapore reported the re-export of approximately 1 t of chips to Indonesia in 1996 and imported a total of approximately 4 t of Indonesian *A. malaccensis* via Malaysia and Taiwan (Province of China) in 1995 and 1996. During the period 1995 to 2001, Singapore reported the total re-export of approximately 1,030 t of Indonesian agarwood to various countries, the largest reported importer being Taiwan (Province of China) (273 t). Of this total, approximately 105 t were reported as pre-Convention stocks between 1995 and 1997. Customs data from Taiwan (Province of China) show imports of 3,224 t of *Aquilaria* spp. from Indonesia between 1995 and 2001.

Between 1998 and 2001, Indonesia reported exports of 305 t of agarwood chips to Singapore, Taiwan (Province of China), Saudi Arabia, Japan and UAE with Singapore being the largest importer, importing about 92% (280 t) of the 305 t of chips. During the same period, however, Singapore reported re-exporting 449 t kg of agarwood designated as *A. malaccensis* in the forms of chips, powder and timber originating from Indonesia to countries such as UAE (8 t), Bangladesh (3 t), China (1 t), Hong Kong SAR (75 t), India (84 t), Japan (13 t), Kuwait (1 t), Saudi Arabia (86 t), Thailand (300 kg) and Taiwan (Province of China) (44 t).

Indonesia did not report any imports of *A. malaccensis* in the period 1998-2001.

Malaysia

Within Malaysia, Peninsular Malaysia, Sabah and Sarawak have their own wildlife trade legislation and CITES-implementing authorities, with each jurisdiction producing its own CITES annual report – no compilation of a national overview is believed to occur. However, UNEP-WCMC data reflects the CITES trade profile of Malaysia in total. While the Malaysian Timber Industries Board (MTIB) serves as the Management Authority in Peninsular Malaysia, and likewise the Sarawak Forestry Department in that jurisdiction, Management Authority responsibilities are less clear in Sabah. Despite the responsibility for CITES-listed timber species clearly resting with the MTIB Sabah according to the CITES Directory of National CITES Authorities, the Sabah Forest Department was nominated by the

Sabah Wildlife Department (overall CITES Management Authority in Sabah) as the responsible agency for all forestry matters, and hence was delegated the responsibility to respond to the questionnaire for this review (A. Tuuga, Sabah Wildlife Department, *in litt.* to TRAFFIC Southeast Asia, 2003). In all Malaysian jurisdictions, the interaction between the various CITES Management Authorities and the CITES Scientific Authority (the Ministry of Science Technology and Environment) regarding the issuance of CITES export permits appears negligible.

CITES annual report data for Malaysia show the export of approximately 2,420 t of agarwood chips from 1995 to 2001. All but 130 t were destined for Singapore. Over that same period, Singapore reported imports of 366 t from Malaysia. Table 4 shows the status of Malaysia's trade data from 1998 to 2002, when some confusion at species level has distorted the available records.

It has been reported that Malaysian agarwood can also be sourced from some *Gonystylus* spp., which are more prevalent in peat-swamp forests. The aromatic wood from *Gonystylus* spp., together with other fragrant woods, is also traded under the name *gaharu*, which further complicates efforts to study trade volumes and trends in *Aquilaria* spp (Barden *et al.*, 2000). Sarawak's 1998 annual report includes data for *A. malaccensis* as well as for "*Aetoxylon malaccensis*", the combined export weight being approximately 528 t. Therefore, it seems likely that *Aetoxylon malaccensis* is actually *A. malaccensis*, but this could not be confirmed. The main export destination in 1998 was Singapore (Barden *et al.*, 2000). In 1999 and 2000, Sarawak's CITES annual reports also included data for *Aquilaria beccariana*, *Aquilaria microcarpa* and *Aetoxylon sympetalum*.

From 1999-2002, Customs data from Taiwan (Province of China) show agarwood imports of 81,457kg from Malaysia.

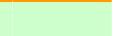
Malaysia did not report any imports of *Aquilaria* spp. during the period of 1998-2001. Neither did the Malaysian State of Sabah report any exports of *A. malaccensis* in that period, although the Sabah Forestry Department recorded the harvest of 567 m³ of *Aquilaria malaccensis* logs, indicating that these logs were most likely processed into sawn timber for domestic consumption (Hassan Baharun, Sabah Forest Department, *in litt.* to TRAFFIC Southeast Asia, 2003).

In 2002, Peninsular Malaysia exported *A. malaccensis* woodchips in amounts of 114,942 kg (to Singapore) and 9,900 kg to Taiwan, Province of China (Malaysian Timber Industries Board, Peninsular Malaysia, *in litt.* to TRAFFIC Southeast Asia, 2003). Taiwanese Customs data show imports of *Aquilaria* spp. totaling 10,728kg from Malaysia as a whole in 2002.

Table 4: Exports (kg) of *A. malaccensis* from Malaysia by administrative jurisdiction 1998-2002

Year	Peninsular Malaysia*	Sabah*	Sarawak*	Total	Exports reported by Malaysia for <i>Aquilaria malaccensis</i> (UNEP-WCMC data)**	Total exports reported by Malaysia for <i>Aquilaria</i> spp. (UNEP-WCMC data)**
1998	31,870	0	527,981	559,851	64,370	630,851
1999	43,530	0	484,660	528,190	43,530	528,190
2000	17,900	0	840,000	857,900	47,600	887,600
2001	32,900	0	0	32,900	32,900	32,900
2002	124,842	0	10,000	134,842	<i>data not yet available</i>	<i>data not yet available</i>

 including other *Aquilaria* species

 only *Aquilaria malaccensis*

Source:

* CITES annual reports from Peninsular Malaysia, Sabah and Sarawak, 1998-2002

** CITES annual report data compiled by UNEP-WCMC

Myanmar

Myanmar became a Party to CITES in November 1997, and UNEP-CITES annual report data do not show any trade in *A. malaccensis* involving Myanmar. No permits have been issued by the Myanmar CITES Authorities for trade in *A. malaccensis* or other *Aquilaria* species (CITES Scientific Authority of Myanmar *in litt.* to TRAFFIC Southeast Asia, 2003). However, customs data from Taiwan (Province of China) show 3,081 kg of *Aquilaria* spp. imports from Myanmar in 2000.

In Myanmar, no official trade data exists for agarwood-producing species, but there is known to be a small harvest for domestic use in traditional medicine. The agarwood trade is conducted mainly underground, as harvest and trade in these species is prohibited under Myanmar's Forest Law (1992). Only one incident of illegal trade has been recorded: in 2001, approximately 4 kg of agarwood was seized in Kachin State by officers of Myanmar's Forest Department. There is known to be illegal felling of *Aquilaria* trees in Sagaing and Thaninthayari Divisions and Kachin State. Mandalay Division may be a transit zone for agarwood illegally harvested (CITES Scientific Authority of Myanmar *in litt.* to TRAFFIC Southeast Asia, 2003).

According to Indian traders, agarwood from Myanmar is in high demand owing to its high quality and, despite the ban, is obtained relatively easily via large-scale smuggling into Manipur, particularly through the district of Churachandpur. In the late 1990s, Indian processing units in Nagaland and Manipur were reported by traders to be supplied partly from Myanmar (the remainder of supplies being from Bangladesh), because of a lack of local sources in India (Gupta, 1999).

Singapore

Singapore is a range State for *A. malaccensis* (CITES Management Authority of Singapore *in litt.* to TRAFFIC Southeast Asia, 2003), and although it does not allow export of agarwood derived from its native populations, Singapore plays a commanding role as an international agarwood trading centre. Virtually no information is available regarding the scale of domestic demand and use of agarwood.

Of all reported agarwood exports (chips, powder and timber, including re-exports) designated as *A. malaccensis* from 1995-2001, 45.4% was exported to Singapore, and 91.1% of all reported re-exports (chips, powder and timber) originated from Singapore.

There is no tax restrictions in Singapore associated with trading *A. malaccensis*. CITES is implemented through the *Endangered Species (Import and Export) Act (Chapter 92A) Revised Edition, 1990*. The Agri-food and Veterinary Authority (AVA) acts as both the CITES Management Authority and Scientific Authority for Singapore. All traders wishing to import or re-export *A. malaccensis* must be licensed by the Singapore Trade Development Board.

CITES import and re-export permits are issued by the AVA. To obtain a CITES import permit for *A. malaccensis*, importers must first present a CITES export or re-export permit issued by the country of export or re-export. Re-exports from Singapore require a CITES re-export permit, with a phytosanitary certificate being issued only if required by the importing country (Lye Fong Keng, Singapore CITES Management Authority, *in litt.* to TRAFFIC Southeast Asia, 16 April 1999). Imports of all other agarwood-producing species also require a plant import permit issued by the Singapore's quarantine authority in addition to a phytosanitary certificate issued by the exporting country (Barden et al, 2000). The Customs and Excise Department works with the AVA to enforce CITES at all Singapore entry and exit points.

Without a valid CITES permit, *A. malaccensis* consignments are refused entry and are either confiscated or returned to the exporting country. The penalty for violating the *Endangered Species Act* is a fine of up to USD5000 and/or imprisonment of up to 12 months. CITES import permits are examined by the AVA prior to the release of agarwood consignments and then scrutinized again when goods are being re-exported. Traders must show that quantities re-exported are less than or equal to quantities imported. Once CITES permits have been issued, the actual agarwood consignments are rarely inspected (Singapore CITES Management Authority, *pers. comm.* to TRAFFIC Southeast Asia, 21 April 1999).

As previously noted at the beginning of Section 4 of this review, various agarwood grading systems are in use. Interviews conducted with traders in Singapore revealed that knowledge of valuation and grading is extremely complex, and a good buyer is said to be able simply to smell the wood and

determine its country and province of origin and grade. Others need to burn portions of the product before making such an assessment. Traders separate out highly resinous products or products with particularly special fragrances to offer to buyers willing to pay high prices (Heuveling van Beek and Phillips, 1999).

Many traders use the practice of placing the wood in water to separate 'sunken wood' from floating woods or flakes, to meet the requirements of their customers from Taiwan (Province of China). Prices for sunken wood in Singapore in the late 1990s were approximately USD 400-500/kg, with Sumatran sunken wood selling for USD 420/kg in Singapore, and sunken wood from Sabah being slightly more expensive at USD 480-500/kg. At that time, traders generally felt that agarwood from Cambodia and Lao PDR was best, selling at USD 2,000-3,000/kg for wood segments. Some Middle Eastern clients preferred wood from Myanmar, however, which has a distinct odor profile. In the late 1990s, samples of agarwood oil distilled in Malaysia could be bought for USD 8450/kg, and superior oil from Cambodia was valued at USD 14,485/kg (Heuveling van Beek and Phillips, 1999).

According to UNEP-WCMC data, from 1995-2001 the total reported exports of *A. malaccensis* to Singapore amounted to 1,584,814 kg, while imports reported by Singapore over the same period totaled 714,309 kg. The substantial discrepancy between reported exports to Singapore and reported imports by Singapore amounts to 870,505 kg; this requires further investigation. In addition, the total reported re-exports from Singapore (originating in Indonesia and Malaysia), amounted to 1,447,211 kg from 1995-2001.

Although not yet detailed in UNEP-WCMC data as Singapore has not yet submitted its CITES annual report for 2002, Singapore imported 170,842 kg of agarwood chips as *A. malaccensis* from Indonesia and Malaysia in 2002. In the same year, Singapore re-exported 317,592 kg of chips as *A. malaccensis* to eight countries in Asia and the Middle East such as Saudi Arabia, UAE, Malaysia, India, Taiwan (Province of China), Japan, Hong Kong and Lao PDR. India, Hong Kong and Saudi Arabia are the top three importers of these chips. A total of 69 CITES import permits and 88 CITES re-exports permit were issued in 2002 (CITES Management Authority, Singapore, *in litt.* to TRAFFIC Southeast Asia, 2003).

From 1999 to 2002, Papua New Guinea reported legal exports of over 18 tonnes of eaglewood (agarwood) derived from *Gyrinops ledermannii* to Singapore (PNG National Forest Service, *in litt.* to TRAFFIC Oceania, 2002).

Table 5: Singapore's trade of *Aquilaria malaccensis* (chips, powder, timber, oil) (kg), 1995-2002

Year	Reported exports to Singapore	Imports reported by Singapore	Re-exports reported by Singapore
1995	345,677	116,581	326,305
1996	417,130	375,882	152,200
1997	350,158	91,046	310,140
1998	173,733	33,550	279,678
1999	79,952	5,000	141,549
2000	127,899	70,950	98,072
2001	90,265	21,300	139,651
2002*	n/a	170,842	317,592
Total	1,584,814	885,151	1,765,187

Source:

CITES annual report data compiled by UNEP-WCMC;

* CITES Management Authority of Singapore

Taiwan (Province of China)

Although Taiwan (Province of China) is not a range State for *A. malaccensis*, information is provided in this report to gain a better insight into this State's role in the agarwood trade, given that it is the largest consumer of *A. malaccensis*, and a significant importer of other agarwood-producing species. Trade in *A. malaccensis* has been regulated in Taiwan (Province of China) since 1998 when all CITES

Appendix II-listed flora were added to the Notes of the Consolidated List of Commodities Subject to Import and Export Restriction & Commodities Entrusted to Customs for Import and Export Examination (Document No. Trade (87)-07691) (Anon., 1999).

Over the period 1995-2001, CITES trade data show that Taiwan (Province of China) was the most important final destination for *A. malaccensis* amounting to 606 t of chips, powder and timber. Of this total, approximately 130 t were exported directly to Taiwan (Province of China) from Indonesia.

Customs data from Taiwan (Province of China) confirm that it is also a major market for agarwood from other species, with over 6,963 t of *Aquilaria* spp. imported from 1993 to 2002. Imports of *Aquilaria* spp. for 1995 to 2001, the period for which CITES annual report data are currently available for *A. malaccensis*, totaled approximately 4,563 t. Over the 10-year period 1993-2002, Customs data show that Indonesia was by far the most important country of origin for agarwood *Aquilaria* spp. imported into Taiwan (Province of China), with total imports from this country of over 4,660 t, nearly five times the import volume from the next-most important source country, Viet Nam, from which imports totaled, 951 t. Thailand and Malaysia remained the third and fourth most important sources of agarwood imports, while Cambodia, which had also been a significant supplier from 1993-1998, does not appear at all in Customs data for 1999-2002.

In 2002, the Bureau of Foreign Trade, in its capacity as the nominated 'competent authority' to deal with CITES matters in Taiwan (Province of China), reported that imports of *A. malaccensis* (10,165 kg) represented only 2.8% of the total imports of *Aquilaria* spp. for 2002, which totaled 357,567 kg (TRAFFIC East Asia-Taipei, *in litt.* to TRAFFIC Southeast Asia, December 2003).

Table 6: Top five sources of *Aquilaria* spp. imported into Taiwan (Province of China), 1993-2002

Country of origin/ export/ re-export	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Total
Cambodia	3 822	54 737	133 819	73 512	35 953	13 224	0	0	0	0	315 087
Indonesia	661 265	491 190	482 874	336 946	302 032	555 229	588 759	500 440	457 985	283 852	4 660 572
Malaysia	43 630	35 451	28 287	44 041	21 275	18 543	1 070	22 996	46 663	10 728	272 684
Thailand	539	83 124	68 342	67 028	42 680	65 570	26 831	54 255	20 755	27 510	456 634
Viet Nam	19 681	84 779	103 068	91 129	96 427	136 685	222 391	101 517	62 517	33 110	951 304

Source: Taiwan (Province of China) Customs Data, compiled by TRAFFIC East Asia-Taipei

Thailand

Thailand exported 243.8 kg of *A. malaccensis* to Singapore in 1997 (Surakai Sangkasubuan, Plant Varieties Protection Office, Thailand Department of Agriculture, *in litt.* to TRAFFIC Southeast Asia, 2003), which is confirmed by CITES annual report data obtained from UNEP-WCMC. The Government of Thailand has not issued any export permits since the end of 1997, because *A. malaccensis* was regarded as threatened in the country (Scientific Authority of Thailand, statement made at the Ninth Meeting of the CITES Plants Committee, Australia, June 1999).

However, additional trade is recorded in Singapore's annual reports. A total of approximately 8 t of agarwood in the form of chips and timber originating in Thailand has been re-exported to a variety of destinations via Singapore from 1995-1997, the vast majority of re-exports occurring in 1995. Only a small percentage of this total (71 kg), in the form of chips and timber, was traded as pre-Convention stock, indicating that Thailand has failed to report the export of the majority of *A. malaccensis* reported to originate from Thailand during this period. According to Singapore's CITES annual reports, Thailand also imported approximately 4 t of *A. malaccensis* chips originating in Indonesia and Malaysia from Singapore in 1997, and 300 kg of *A. malaccensis* chips originating in Indonesia from Singapore in 1998. Thailand does not appear again in current UNEP-WCMC data until 2001, when China reported exports of 26kg of *A. malaccensis* derivatives to Thailand.

Customs data from Taiwan (Province of China) show imports of approximately 457 t of *Aquilaria* spp. of Thai origin between 1993 and 2002 – making Thailand the third-largest supplier of

agarwood to Taiwan during that period (see Table 6, above). Whether this indicates illegal exports of native *A. malaccensis* or *A. crassna* specimens from Thailand, or a mixture of domestically harvested agarwood with that sourced from other range States, remains largely unknown. However, this is a potentially large discrepancy between the two data sets.

5. Other relevant information, including on artificial propagation

Bangladesh

Since 1998, the Government of Bangladesh has started planting *A. agallocha* as part of the Agar plantation project in Sylhet, Chittagong, Chittagong Hilltracts and Cox's Bazaar forests (A. Faruque, Chief Conservator of Forest, Bangladesh, *in litt.* to TRAFFIC Southeast Asia, 2003).

Bhutan

Trial plantations established in Panbang and Samdrup Jongkha in the 1980s have been successful in terms of growth but not in terms of agarwood production (Chamling, 1996). An *Aquilaria* plantation was established approximately 25 years ago in Royal Manas National Park. In 2001, the plantation had an estimated 600 to 700 trees (H. Heuveling van Beek, *in litt.* to TRAFFIC Southeast Asia, 2003).

India

The Silviculture Division of Arunachal Pradesh has converted large areas of degraded forests into commercial agarwood plantations. The upper Assam climate provides particularly suitable growing conditions and large-scale plantations have been developed with the support of the Assam Ministry of Forestry since the late 90s, and may become a cornerstone of the State's Forestry Action Program. Owners of private plantations in Assam have also attempted artificial fungal inoculation of two- to three-year-old *A. malaccensis* plants, but it is not known how effective this has been in stimulating agarwood production. The Research and Development Department of an international agarwood trading company maintained in the late 1990s that private Assam plantations had been fulfilling 70-80% of the world's demand for agarwood, but this seems very unlikely based on available trade data. Traders interviewed in the late 1990s also believed that private plantations could meet the demands of existing processing plants and they were therefore confident regarding continuance of the agarwood trade. However, evidence of CITES-reported exports from India indicates that this is not the case.

Surveys undertaken by the CITES Management Authority in Tripura estimate that approximately 450-500 ha of private agarwood plantations exist in the State's north district. Government plantations also existed in Tripura in the late 1990s, where the Forest Department first created plantations in the 1960s. There has been little effort to create agarwood plantations in either Mizoram or Meghalaya. Some government plantations can be found in Nagaland and Manipur, but there are few private plantations in these States (Gupta, 1999).

In India plantation exists in Sibsagar, Assam and in a few other places but the development of agarwood is not well researched in these stands. Around Barapani, Assam, a plantation was raised as early as 1921 but trees were all felled by the 1960s. The silviculture division of Arunachal Pradesh has made attempts at experimental plantation (Misra *et al.*, 1998). The species is also cultivated in Meghalaya but Chakrabarty *et al.* (1994) reported that only 100 trees remained.

Germplasm of *A. malaccensis* is being maintained in experimental garden for *ex-situ* conservation in the Botanical Survey of India's Arunachal Field Station and that state's Forest Research Institute while various private nurseries are also maintaining a very good germplasm collection of this species. Public awareness is being created among the local inhabitants by Botanical Survey of India and Forest Department along with various NGOs to preserve this species in home gardens and in its natural habitat (G.S.Giri *in litt.* to TRAFFIC Southeast Asia, 2003).

Indonesia

Indonesia is one of only two countries (the other being Malaysia) detailed in CITES annual report data as having exported artificially propagated specimens of *A. malaccensis*.

Successful efforts to cultivate *Aquilaria* species have been initiated in several provinces and some traders have established plantations, e.g. in Riau (Sumatra), Lombok and Bogor (Java) (Wiriadinata, 1995). Research is underway on the inoculation of *Aquilaria* trees with agarwood-producing fungi. Research is also ongoing regarding the ecology of agarwood-producing species, including the *in-situ* study of their natural regeneration (Soehartono and Mardiastuti, 1997). *A. malaccensis* plantations are reportedly found in some provinces (West Kalimantan, East Kalimantan, South Kalimantan, Riau Daratan, Jambi, Bengkulu, Banten, West Java). *Gyrinops* spp. is believed to be cultivated along with other agarwood-producing species in Lombok (T. Soehartono, in litt. to TRAFFIC Southeast Asia, December 2003).

Considerable efforts have been made by Indonesian authorities and ASGARIN (Indonesian agarwood traders' association) over recent years to improve the management of gaharu harvests. Traders are now well aware of the need to ensure harvests are sustainable and have repeatedly demonstrated their willingness to support researchers and research programs, including recent work on the artificial propagation of gaharu trees. However, without scientific data, it is very difficult to convince the traders and exporters that the current volumes of wild harvest are not sustainable for *A. malaccensis* (Irawati and Wiriadinata, *in litt.* to TRAFFIC Southeast Asia, 30 April 2003), and neither for all other agarwood-producing species (T. Soehartono, *in litt.* to TRAFFIC Southeast Asia, December 2003).

Based on the information provided by the ASGARIN, several companies have begun, along with local communities, artificial propagation of *A. malaccensis* (see Table 7). Some plantations have been established for more than 10 years, but progress has been slow in terms of the volume of agarwood produced. However, research and studies on agarwood continue (Irawati and Wiriadinata, *in litt.* to TRAFFIC Southeast Asia, 30 April 2003).

Table 7: Details of Gaharu plantations established by exporters in Indonesia

Company / local community	Location	Area of plantation
PT. Budi Daya Perkasa	Sumatra	15 ha
CV. Megah Aroma Utomo	Sumatra	3 ha
CV. Subur Raya	Sumatra	3.5 ha
Jambi local community	Sumatra	30 ha
Lampung local community	Sumatra	10 ha
Metro local community	Sumatra	1000 trees
Mentawai community	Sumatra	2 ha
PT. Sumber Alam Jaya	Kalimantan	3 ha
CV. Kuda Mas	Kalimantan	2 ha
Dayak community – Central Kalimantan	Kalimantan	2 ha

Source: CITES Management Authority, Indonesia, *in litt.* to TRAFFIC Southeast Asia, 30 April 2003

On-going research on inoculation is being conducted by Seameo – BIOTROP in Bogor in the hope that such technology could be used to enhance agarwood production from cultivated *Aquilaria* trees. Efforts to successfully manage agarwood production from *Aquilaria* plantations need further research on wood anatomy and identification of microbial infections (CITES Scientific Authority, *in litt.* to TRAFFIC Southeast Asia, 2003).

Malaysia

Malaysia is one of only two countries (the other being Indonesia) detailed in CITES annual report data as having exported artificially propagated specimens of *A. malaccensis*.

One of the first attempts to cultivate *Aquilaria* occurred in Malaysia in 1928 (Lok and Zuhaidi, 1996). Natural mortality caused the original population density of this stock of 833/ha to decrease to 31/ha by 1995 and it is unknown whether any of these trees produce agarwood. Additional research has shown that *Aquilaria* can be artificially propagated and there are continuing laboratory experiments to stimulate agarwood formation. There is private sector interest in this area and a committee involving the Forest Research Institute of Malaysia and private foreign companies has been established to

further examine agarwood research and development (Dr C.Y. Shyun, Medicinal Plants Division, FRIM, *in litt.* to TRAFFIC International, 8 May 2000).

Myanmar

A small trial plantation (5 acres) of *A. malaccensis* has been established in the Myeik (formerly Mergui) region in the south of the country. Future research is planned on the process of agarwood formation and the use of inoculation techniques (CITES Scientific Authority of Myanmar, *in litt.* to TRAFFIC Southeast Asia, 2003).

Thailand

A plantation of *A. crassna*, known as the Gridsanah Botanical Gardens of Aloeswood, was established in 1994. The status of this and any other plantations in the country is unclear (Heuveling van Beek and Phillips, 1999). There is known to be a large plantation of *A. crassna* near Trat, in eastern Thailand bordering Cambodia, which is believed to have been established in the early 1980s (TRAFFIC Southeast Asia, *in litt.* to the CITES Secretariat, 2003).

Viet Nam

A Dutch-based NGO, The Rainforest Project Foundation (TRP) has been working with the National University of Ho Chi Minh City in Viet Nam for since 1995 on developing treatment techniques to enhance natural agarwood formulation. Trials on selected wild stands, as well as plantation plots have been conducted, concentrating on *Aquilaria crassna*. Project results were presented at the First International Agarwood Conference in November 2003 in Ho Chi Minh City, Viet Nam, and will be formally published in scientific journals in the near future (see <http://www.agarwood.org.vn/index.htm> for more information).

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Provisional categorizations for *Aquilaria malaccensis* in accordance with paragraph i) of Resolution Conf. 12.8 on Review of Significant Trade in specimens of Appendix-II species

Explanatory note

In accordance with Resolution Conf. 12.8, paragraph i), the consultant summarized the conclusion about the effect of international trade in *Aquilaria malaccensis*, and provisionally divided its range States into three categories. Within these categories, range States with similar characteristics are grouped together where appropriate. Issues that are taken into account for these groupings include the conservation status of the species in the range State, the relative importance of the export in relation to the status of the species, the scale and scope of the trade (exporter, re-exporter or importer), the nature of the harvest, the main uses (domestic or international) and the management measures already in place. A brief justification for the proposed grouping and categorization of range States is provided. It is hoped that the Plants Committee finds this format useful when formulating recommendations.

1. 'Species of urgent concern' for which the available information indicates that the provisions of Article IV, paragraph 2 (a), 3 or 6 (a), are not being implemented

Malaysia (Peninsular Malaysia and Sarawak) is proposed for inclusion in this category because there is considerable concern about the relatively high levels of exports from these two administrative jurisdictions, in company with insufficient information on wild populations and trends, and the absence of adequate measures that assist in the monitoring of harvest and export volumes. There is no indication that any quotas for harvest or export are in use, nor that any non-detriment finding methodology has been developed or applied. Of paramount concern is the apparent lack of involvement by the CITES Scientific Authority in assessing levels of agarwood harvest and trade in any Malaysian jurisdiction. Reports of *A. malaccensis* being harvested illegally in all three Malaysian jurisdictions, and the suggestion that some of this harvest may be also traded illegally also need further investigation. Peninsular Malaysia has stated that the current Forest Inventory (begun in 2002) will include *A. malaccensis* at species level, but it will most likely be some time before sufficient population estimates are available, and additional work will likely be required to formulate reliable conclusions.

Recommendations:

- a) The CITES Scientific Authority of **Malaysia** should convene, in conjunction with the Malaysian Timber Industries Board (MTIB – the CITES Management Authority for tree species in Peninsular Malaysia), the Sarawak Forestry Department (the CITES Management Authority for Sarawak), the Forest Research Institute of Malaysia (FRIM) and associated technical experts, a working group to develop robust Non-Detriment Finding methodology to be used to monitor agarwood harvest and trade.
- b) Under the laws of both Peninsular Malaysia and Sarawak, legal harvest of and trade in agarwood is regulated by a permit system, prior to the application and issuance of a CITES permit for export. A list of permits issued on an annual basis from 1998-2002, cross-referenced to harvesting locations, would assist greatly to clarify i) how much of the agarwood harvest and trade is legal from these two Malaysian jurisdictions; ii) how harvest and trade might be being managed, or could be better managed; and iii) to cross-check the trade statistics.

2. 'Species of possible concern' for which it is not clear whether or not the provisions of Article IV, paragraph 2 (a), 3 or 6 (a) are being implemented

India is proposed for inclusion in this category, despite there being a moratorium in place for exports of native wild Indian *A. malaccensis* populations. The exceptions to the current export ban include formulations, which are defined as products containing plant portions or extracts in unrecognizable and physically inseparable forms. Native wild *A. malaccensis* can therefore be freely exported in forms such as oil or medicine. Also, the export of Indian 'cultivated' varieties (*i.e.* agarwood derived from plantations) is permitted when accompanied by a Certificate of Cultivation, along with a CITES permit. Considered alongside available CITES trade data that shows India as a significant re-exporter and also an exporter of oil and extract from wild sources, as well as the uncertainty over whether there is any non-detriment finding methodology in use for the export of 'formulations' including native *A. malaccensis* ingredients, there is some concern about the completeness and effectiveness of the current regulatory and management provisions. Additionally, the export of 5600 kg of *A. malaccensis* powder of wild origin in 2000 to Singapore (not reported by India in its annual report) is of concern given the critical conservation status of the species in India and that this appears to be in contravention of India's export policy.

Indonesia is also proposed for inclusion in this category. Quotas for the harvest and trade of *A. malaccensis* have been established. The Scientific Authority of Indonesia has recognized that the species cannot support the same quota volumes as in previous years, and has voluntarily reduced the quota by 33% (from 75 t to 50 t) in 2003, which gives some indication of a precautionary management approach. However, clarification is required on the NDF methodology in use, as the extent of available wild population data available appears to indicate a lack of scientific rigour in the basis of these quotas. It is also worth noting that Indonesia's quotas for both harvest and export of *A. malaccensis* also include four other agarwood-producing species, thus obscuring the ability to monitor the effect of harvest and trade on *A. malaccensis*.

Recommendations:

- a) **India** should clarify the regulatory and management framework currently in operation that distinguishes imported stock from any production from native populations. In addition, there should be some consideration given to implementing a Non-Detriment Finding process for "formulations" derived from *A. malaccensis*. The current level of *A. malaccensis* plantation development in northeast India, particularly the State of Assam suggests that if plantation agarwood is to become an important part of the State's forest management strategy, trade regulations relative to India's national legislation may need to be re-examined to ensure that incentives for good management are in place.
- b) Although operating on an increasingly precautionary basis in setting annual quotas, **Indonesia** is asked to clarify the methodology currently being used for the Non Detriment Finding assessments, with particular attention being paid to the calculation of the real amount of *A. malaccensis* (within the quota including four other agarwood-producing species) being harvested and traded. Indonesian authorities, including the representative to the CITES Plants Committee have agreed that developing robust NDF methodology is a priority, and have agreed to work with the Indonesian agarwood trading association to achieve this. However, this consultative process should be moved forward into the technical phase as a matter of priority.

3. 'Species of least concern' for which the available information appears to indicate that the provisions of Article IV, paragraph 2 (a), 3 or 6 (a) are being met

Bangladesh, Bhutan, Myanmar and the **Philippines** have not exported *A. malaccensis* from 1995-2001 according to CITES annual report data. Additionally, harvest is prohibited in Bhutan and Myanmar. Therefore, the species in these four countries is proposed as being of least concern. However, there are no harvest or trade controls in Bangladesh, so should exports be permitted in future, the categorization for Bangladesh will need to be revisited.

The State of **Sabah**, as part of **Malaysia**, is also proposed for inclusion in this category on the same basis. No international export of *A. malaccensis* has been reported from Sabah during the period 1997-2001, but it would be useful to clarify whether the possibility of internal transport of *A. malaccensis* cargoes between Sabah and the other two Malaysian jurisdictions is being monitored by relevant authorities, and how many harvesting permits for *A. malaccensis* are issued in Sabah on an annual basis. As harvest is possible under a permit system, should exports occur in future, the categorization for Sabah will need to be revisited.

Thailand is proposed for inclusion in this category because it has not issued any export permits for *A. malaccensis* since 1997, and that the practice of not permitting exports is expected to continue given that the species is regarded as threatened in the country. As with Bangladesh, should exports be permitted in future, the categorization for Thailand will need to be revisited.

Problems identified in the course of the review that are not related to the implementation of Article IV, paragraph 2 (a), 3 or 6 (a)

In compliance with paragraph k) of Resolution Conf. 12.8, the consultant has identified other issues of concern in range States than those specifically related to the implementation of Article IV, and that are to be addressed by the Secretariat in accordance with the appropriate provisions of the Convention and relevant Resolutions.

Singapore is the largest global player in the agarwood trade, despite its legislation prohibiting exports of its native populations of *A. malaccensis* and other agarwood-producing species. However, the discrepancy between Singapore's reported imports and reported exports, in tandem with its extremely

high re-export data, gives some cause for concern that potentially its own populations may be contributing to the specimens reported as re-exports. It is therefore suggested that Singapore be asked to clarify how it controls imports and re-exports, particularly with regard to differentiating between individual agarwood-producing species.

Quality of reporting trade in *A. malaccensis*

Insufficient reporting of trade is a problem with a number of range States and needs to be addressed. There are numerous examples in CITES annual report data of significant volumes of *A. malaccensis* specimens in trade being reported by only one of the pair of trading Parties in any given year, or of reported volumes of what appears to be the same trade transaction, differing greatly. In the vast majority of case, this is not, or is unlikely to be explained by the usual problems associated with the analysis of CITES data. For example, one Party not having submitted annual reports for the year in question, the six month validity of permits (whereby export can occur in one year, and not be reported by the importer till the following year), or the basis for compiling annual reports (permits issued versus actual trade). The reason for the mismatch of annual report data indicate that greater attention needs to be paid by both exporting and importing Parties to accurately reporting trade in *A. malaccensis*.

For example, **Thailand** has only reported exporting a total of 244 kg of *A. malaccensis* (all in 1997, for which there is a similar corresponding amount reported in Singapore's import data). However, Singapore has reported re-exporting 7663 kg of *A. malaccensis* of Thai origin from 1995-1997, none of which was reported to be pre-Convention stocks. Unless Singapore has incorrectly stated the source of these specimens, this indicates that Thailand has failed to report the export of the majority of *A. malaccensis* reported to originate from Thailand during this period. This is just one of several similar examples (another being **India** as noted above).

Additionally with regards to **Thailand**, there are significant levels of import of *Aquilaria* spp. into Taiwan (Province of China). Indeed according to Taiwanese Customs data, Thailand is the third-largest supplier of agarwood to this State from 1993 to 2002. Given the problems differentiating between different *Aquilaria* species in trade, whether this indicates illegal exports of native *A. malaccensis* or *A. crassna* specimens from Thailand, or a mixture of domestically harvested agarwood with that sourced from other range States (and hence potentially including *A. malaccensis*), remains largely unknown. However, this should be investigated further.

Illegal harvest and trade is recorded for most range States, much of it coming from already protected areas. Given that the international demand and the value of *A. malaccensis* is likely to remain high, this issue needs to be addressed and enforcement measures strengthened.

Agarwood oil made from *A. malaccensis* rarely appears in CITES trade data, and yet oil is one of the more common forms observed for sale. Although oil may be processed from other forms of agarwood in various countries, and if exports of oil including *A. malaccensis* are not clearly labelled, they would not be considered as being readily recognizable according to Resolution Conf. 9.6: this may also indicate illegal trade in agarwood oil and therefore this needs further investigation.

Relative to the current CITES Decisions 12.66-12.71 the following recommendations are made:

Regarding **Decision 12.66** and the DNA identification tools, this work should be extended initially to clarify the taxonomic uncertainty over whether *A. malaccensis* and *A. agallocha* are in fact the same species. The first phase of the project made preliminary conclusions that the genus *Aquilaria* was polyphyletic rather than monophyletic, but more molecular data are needed to clarify this hypothesis. An identification tool for determining dry-wood chips to species level is still urgently required. Promising results from a pilot study investigating a molecular approach would need to be extended in order to develop an operational molecular test and to examine applicability. More plastid gene regions need to be sequenced and if possible nuclear genes as well to create a robust data-set necessary for the development of the molecular test and very useful to produce a evolutionary classification.

Regarding **Decision 12.67**, improved information on distribution of species remains a key component of improved trade reporting and discriminating between species. It is recommended that this work be conducted in conjunction with both the taxonomic/identification research (see 12.66), and also to feed into the very much needed re-evaluation of the threatened status of all agarwood-producing taxa according to the IUCN Red List criteria (see **Decision 12.69**).

This review has confirmed that it is impossible, in practical terms, to distinguish between agarwood species at product level, whether it be traded in the form of timber, wood chips, powder (dust), oil or incense/perfume derivatives. With reference to **Decision 12.68** and the need to include all agarwood-producing taxa in further studies, it is recommended that the Plants Committee consider whether in fact the discussion of whether a listing of all agarwood-producing taxa on CITES Appendix II would help harmonize management of harvest and trade – and actually aid in the development of a long-term sustainable industry.

The two major range State ‘producers’ of *A. malaccensis* agarwood, namely Indonesia and Malaysia, have had recommendations made by this review regarding the need to develop and clarify robust NDF methodology, following **Decision 12.70**. There is no reason that these guidelines or checklist(s) should be developed in isolation, and by field-testing of such methodologies in more than one range state could enable the results to be both practical and verifiable. By extension, once these approaches are developed and tested, they can be applied to all of the agarwood-producing taxa, and take into account both in-situ and ex-situ production systems [i.e. including plantations and the use of ‘treatment’ technology to induce agarwood formation]. It is therefore recommended that a working group be convened, including experts from both Indonesia and Malaysia, relevant representatives of the CITES Plants Committee, and experts from other relevant range states for agarwood-producing species.

While work has begun on describing the particular character of the market demand in East Asia (focused on Japan and Taiwan, province of China), more funding support is critical towards understanding the nature of demand – and by association, the cultural and religious importance of securing long-term agarwood supply – in the Middle East (focused on Saudi Arabia and United Arab Emirates as the largest importers of *A. malaccensis*). Any additional funding raised through the efforts of the CITES Plants Committee and the CITES Secretariat towards this work would greatly aid the delivery of **Decision 12.71**.

