

CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

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Species specific matters

Agarwood-producing taxa (*Aquilaria* spp. and *Gyrinops* spp.)

THE HISTORY AND CHALLENGES OF AGARWOOD AND CITES

1. This document has been submitted by the United Kingdom of Great Britain and Northern Ireland.*

This document summarises the main decisions and discussions in CITES about agarwood (specifically *Aquilaria* and *Gyrinops*) from 1994 to the present day, including an introduction to agarwood taxonomy and production, conservation status, overview of international trade, conservation management in range States, legalisation and quotas. It also provides recommendations on areas of future research to support the sustainable trade of agarwood.

Executive summary

Agarwood, commonly known as oud, gahuru, aloewood and eaglewood is a fragrant wood which has been used for centuries as a perfume, herbal medicine and for religious and cultural purposes (Barden et al. 2000; Antonopoulou et al. 2010; López-Sampson & Page 2018). It is reported to be the most valuable wildlife commodity in the world (Gratzfeld & Tan 2008; UNODC 2016), but due to an increase in global demand and the slow formation of the resinous wood, the supply of agarwood has decreased (Yin et al. 2016) and wild populations are threatened with extinction.

The first international trade of agarwood dates back to ancient Romans and Greeks who traded in aromatic products, including agarwood with India and later China (López-Sampson & Page 2018). Within Asia, there are records of agarwood trade from Vietnam and Cambodia to China in the 4th century AD (López-Sampson & Page 2018). Today agarwood trade is complex with multiple species being traded and products moving from their country of origin to the final consumer often through many intermediary countries.

As agarwood has been used traditionally for centuries, many source countries rely on its products and the income generated from the trade (Barden et al. 2000). The result is people's livelihoods depend on it and would be negatively affected should agarwood producing taxa go extinct, or if trade in agarwood and its products were completely banned (EC 2018). This trade is at times the only opportunity to generate income for communities with a low socio-economic status (Arnold & Ruiz Perez 1998). A decline in agarwood trees and subsequent harvesting of other non-timber forest products not only negatively affects the income of those relying on this trade but the resilience of forests and wild areas. Studies across the Asian region have highlighted decreasing trends in export yield and revenue (Azren et al. 2021).

Agarwood has a long history in CITES with *Aquilaria malaccensis* first listed in Appendix II in 1994, followed in 2004 by the listing of the genera *Aquilaria* and *Gyrinops* in Appendix II. Over the years many workshops have been held, reports written and working groups formed to discuss many topics about agarwood, including the difficulties in identification of agarwood species, legal and illegal trade, developing a glossary and writing Non-

* The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.

Detriment Findings (NDFs). Over 200 documents are listed on the CITES website (www.cites.org) discussing agarwood, including decisions, resolutions, reports, working groups, workshops and meeting minutes, which are summarised in part 2 of this working document.

In order for sustainable agarwood trade to continue to contribute to livelihoods and cultural practices work on species identification including molecular phylogenetic studies and a review of the standard CITES nomenclature for *Aquilaria* and *Gyrinops* is required. This alongside a standard reference collection of wood and oil samples of all *Aquilaria* and *Gyrinops* species from range States are needed as a foundation for the implementation of CITES regulations for agarwood producing taxa. This synopsis found a need to identify the availability and location of practical tools and techniques for custom officers to accurately identify agarwood products at country borders. Additionally, the agarwood CITES glossary should include more detailed definitions of agarwood products to aid customs officers. Aspects requiring attention include exact measurements of chips and powder and defining the percentage oil content of exhausted and non-exhausted powder.

To further current conservation efforts it is recommended a survey of the size and status of wild populations of agarwood species to aid in NDFs and Red List reassessments, particularly for *Aquilaria* species assessed as Data Deficient is done to identify those species threatened by population decline. In the spirit of the Convention, it needs to be determined whether Appendix II is merited for the specie *Aetoxylon sympetalum*. An investigation of the wild population status and trade of this species is suggested to determine if it is threatened by international trade and its similarity to *Aquilaria* species.

1. Introduction

The term 'Agarwood' is used to describe a highly fragrant resinous timber, formed by a small number of tropical tree species. Humans have been aware of and made use of agarwood's unique chemical properties for more than a millennium. Agarwood was first recorded in text in poetry circa 353 to 420 AD (Lee et al. 2016) and the first written records of people using agarwood was in Arabian texts in 800 AD (López-Sampson & Page 2018). Its use in medicine and as a perfume were recorded in the Sahih Muslim, Old Testament, Hindu Sanskrit text Mahābhārata and ancient Buddhist texts (Barden et al. 2000; Lee et al. 2016; López-Sampson & Page 2018) and it remains important today in Buddhist, Hindu and Islamic traditional ceremonies (Gratzfeld & Tan 2008). In recent decades, the production and use of agarwood has developed into a lucrative global industry, supplying international consumers with luxury oils, perfumes, and incense, which are used in both traditional and non-traditional settings.

1.1 Agarwood taxonomy

Agarwood mainly refers to products derived from the two genera *Aquilaria* and *Gyrinops*, both in the Thymelaceae family and they both occur in tropical forests in Southeast Asia from eastern India eastwards to Papua New Guinea (POWO 2021). Molecular phylogenetic studies of the two genera have shown they are very closely related and raised doubts if they should continue to be recognised as two separate genera (Eurlings & Gravendeel 2005; Farah et al. 2018). Currently they are separated by the number of number of stamens, with *Aquilaria* having eight to twelve, and *Gyrinops* having only five (Lee et al. 2018). *Aquilaria* contains 21 accepted species and *Gyrinops* nine accepted species (POWO 2021), in CITES standard nomenclature (UNEP-WCMC 2022b) there are 25 accepted species of *Aquilaria* and eight species of *Gyrinops* listed.

In *Aquilaria*, 13 species are reported to produce agarwood resin; *A.baillonii*, *A.beccariana*, *A.crassna*, *A.filaria*, *A.hirta*, *A.khasiana*, *A.malaccensis*, *A.microcarpa*, *A.rostrata*, *A.rugosa*, *A.sinensis*, *A.subintegra* and *A.yunnanensis* (Lee et al. 2016). Currently it is unknown whether the eight other species of *Aquilaria* also produce agarwood (Lee et al. 2016). In *Gyrinops*, four species, *G.caudata*, *G.ledermanii*, *G.versteegii* and *G.walla*, are reported to produce agarwood (Subasinghe & Hettiarachchi 2013; Auri et al. 2021).

There are five other genera which produce agarwood-like resinous wood, in Thymelaceae; *Aetoxylon* (with one accepted species, *A.sympetalum*), *Enkleia* (three species), *Gonystylus* (32 species), *Phaleria* (25 species) and *Wikstroemia* (90 species) (Wyn & Anak 2010; POWO 2021). *Aetoxylon sympetalum* is traded as white oud or gaharu buaya, and in Sarawak, Malaysia, has been reported to be one of the main sources of agarwood (Wyn & Anak 2010). Its fragrant wood is considered to be less important by comparison to *Aquilaria* and *Gyrinops* (Rasool & Mohamed 2016). It is not listed on CITES and information on the quantities in trade, threats in the wild and its global conservation status is unknown. Indonesia has assessed the species as Critically Endangered mainly due to its small population size and forest loss. The trade of *Enkleia*, *Phaleria* and *Wikstroemia* for agarwood products is unknown, whilst *Gonystylus* is mainly traded as ramin and used for furniture.

1.2 Agarwood production and harvesting

Agarwood refers to the dark resinous wood produced by the trees in a stress response mechanism to injury and infection by fungi, from broken branches from storms, or attacks by microbes and insects (Chen et al. 2012; Rasool & Mohamed 2016; Azren et al. 2019; Naziz et al. 2019). Many genera of fungi have been identified in agarwood samples (Naziz et al. 2019; Faizal et al. 2020), with *Lasiodiplodia*, *Fusarium* and *Trichoderma* all shown to induce agarwood formation in *Aquilaria sinensis* (Liu et al. 2019).

Normal healthy agarwood wood is light brown in colour, but the infected wood becomes dark brown to black and resinous (Naef 2011). *Aquilaria* tree roots can contain resinous agarwood and are sometimes harvested and sold (Barden et al. 2000).

Harvesting from wild trees can involve indiscriminately cutting down trees as external signs a tree has produced agarwood, or the quality of agarwood, is not always visible until cut (Barden et al. 2000; Chua 2008). Experienced collectors can identify signs of agarwood formation on the trees (Chakrabarty et al. 1994) and some communities, (the Dayak community in Indonesia), can identify agarwood producing trees by knocking on the tree trunks and listening to the different sounds (Barden et al. 2000). Sustainable wild harvesting methods are used in Sarawak, Malaysia and in East Kalimantan, Indonesia, villagers only cut out a small part of the *Aquilaria* tree's trunk where resinous wood is found, allowing the tree to continue to grow (Soehartono & Newton 2002; Kanazawa 2017) and coppicing trees has been reported in Borneo (Gratzfeld & Tan 2008).

To improve the supply of agarwood and to help prevent overharvesting in the wild, many range States have begun growing *Aquilaria* trees in plantations (Lee et al. 2018) and using artificial inoculation to stimulate production of resinous woods (Naef 2011; UNODC 2016; López-Sampson & Page 2018). Young plantation trees are physically wounded and/or inoculated with fungi or chemicals, then the wound site is prevented from healing by insertion of nails, screws, wood or plastic (Naef 2011; Azren et al. 2019; Naziz et al. 2019; Faizal et al. 2020). After one to two years the trees can be harvested for agarwood (Naef 2011). Research on sustainable production of agarwood in plantations has shown fungal inoculation of branches could allow repeated harvesting from the same tree (Faizal et al. 2020).

The quality of agarwood from cultivated *Aquilaria* is often perceived to be of lower quality than wild harvested agarwood and is used to produce oil (Kanazawa 2017) or low value wood chips and incense (Compton & Ishihara 2004). Due to the high value of commercial trade, there has often been little exchange of information by producers on the best sustainable production methods for cultivating agarwood (Gratzfeld & Tan 2008). Scientific research to improve inoculation methods in cultivated *Aquilaria*, aimed at ensuring cultivated agarwood reaches the same level of quality of wild harvested agarwood is ongoing (Azren et al. 2019).

There is less production of agarwood on a commercial scale for *Gyrinops* species than there is for *Aquilaria* species (Naziz et al. 2019) and plantations of *Gyrinops* are rare as the trees are slow growing (Lee et al. 2018). Research on the best methods and optimum fungi to use to induce agarwood formation in *Gyrinops* is ongoing (Subasinghe & Hettiarachchi 2013; Faizal et al. 2020; Auri et al. 2021).

1.3 Agarwood products

Agarwood is mainly sold commercially as wood chips, powder, resin balls and incense sticks for burning, perfume oil, herbal medicines, prayer beads and wood carvings (Barden et al. 2000; Antonopoulou et al. 2010; Espinoza et al. 2014; Lee et al. 2016). Oil is distilled from agarwood chips in the country of origin or in one of the major re-exporting countries (Antonopoulou et al. 2010; Groves & Rutherford 2015). Often lower quality chips or powder are used to distill oil, and once the oil has been extracted the remaining powder (called "exhausted" powder) is used to make lower cost incense or compressed into statues (Barden et al. 2000; Antonopoulou et al. 2010; Groves & Rutherford 2015). Oils can be sold as pure agarwood oil or mixed with other fragrances (musk and sandalwood) to make a blended perfume (Barden et al. 2000; Antonopoulou et al. 2010). Wood chips, sawdust and incense balls or sticks are often sold coated or blended with scented oils or mixed with other fragrant plants (Barden et al. 2000; Compton & Ishihara 2004; Lancaster & Espinoza 2012).

Herbal medicines containing *Aquilaria* are becoming increasingly popular and are used in Chinese, Ayurvedic and Tibetan herbal medicines (Chakrabarty et al. 1994; Kalita et al. 2020). In Traditional Chinese Medicine *A. sinensis* is used to treat asthma, digestive problems, pain relief and insomnia (Liu et al. 2019; Kalita et al. 2020), and recently medicines containing this species were recommended in China to treat COVID-19 (TRAFFIC 2022b).

Due to the high demand and value of agarwood there has been an increase in adulteration of agarwood products (López-Sampson & Page 2018), including substituting agarwood with other fragrant woods (wooden agarwood beads of other wood species soaked in agarwood oil (UNODC 2016)). Lower cost agarwood products are produced using low quality agarwood chips impregnated with agarwood oil and alcohol (Antonopoulou et al. 2010). Synthetic agarwood oils can be found in low quality perfumes and incense, but they are not considered to be high enough quality to replace genuine high grade agarwood oil (Barden et al. 2000).

Agarwood wood chips and oil are graded to determine the quality and prices by expert graders, often with decades of experience, who study the country of origin of the agarwood, size, shape and weight of wood chips, resin content, fragrance and colour of chips and the purity of oil (Barden et al. 2000). Country of origin and wood quality are the most important factors for graders, species type is less important (Barden et al. 2000). Research has been done on new grading techniques, chemical analysis of resin content (Azren et al. 2021) or analysing photographic images of wood chips to identify lower grades of agarwood (Abdullah et al. 2007). Oils are harder to grade but some agarwood companies are using gas chromatography and high-performance liquid chromatography to test the purity of oil (Barden et al. 2000).

1.4 Identification

Accurate identification of the specific *Aquilaria* or *Gyrinops* species found in agarwood products is a developing research area. Traditionally agarwood wood products are identified using anatomical sections and light microscopy, with comparison against reference microscope slide collections or InsideWood, a database with coded wood anatomy characters (Gasson 2011; Wheeler 2011). Identification of *Aquilaria* or *Gyrinops* using these anatomical techniques is only possible to genus, rather than species level (Gasson 2011). Identification of trees in the field is difficult, as flower and fruit characters which are important in distinguishing species of *Aquilaria* and *Gyrinops* are only seasonally present (Lee et al. 2018).

Resinous agarwood contains a complex mixture of chemicals (Naef 2011; Espinoza et al. 2014), many of which do not occur in the non-resinous normal agarwood wood (Chen et al. 2012). Direct Analysis in Real Time ionization coupled with Time-of-Flight Mass Spectrometry (DART-TOFMS) and statistical analysis has been used to identify these chemicals, and distinguish agarwood wood chips originating in natural forests, from those cultivated in plantations, in *A. beccariana*, *A. crassna* and *A. sinensis* (Espinoza et al. 2014). DART-TOFMS studies have shown these techniques could identify the geographic origin of wood chip samples (Espinoza et al. 2014), the presence of *Aquilaria* in wood chips, sawdust, incense and liquids (Lancaster & Espinoza 2012) and detect ions to differentiate agarwood wood chips from 25 scented woods of non-agarwood species (Lancaster & Espinoza 2012).

Studies have been undertaken using other molecular methods, ultra-performance liquid chromatography coupled with electrospray ionization mass spectrometry (UPLC–ESI-QTOF-MS) has been used to distinguish wild and cultivated *Aquilaria sinensis* (Li et al. 2016). Chemotaxonomy using two-dimensional thin layer chromatography has identified mangiferin in leaves of six species of *Aquilaria* and could be used to help identify *Aquilaria* leaf samples (Andary et al. 2019). Liquid-chromatography-mass-spectrometry (LC-MS) has been used recently at the Royal Botanic Gardens, Kew to compare reference agarwood collections with seized material. DNA barcoding is a rapidly developing field and research has been undertaken using leaf, fruit and wood samples from wild and cultivated sources of agarwood in Indonesia to identify species of *Aquilaria* and *Gyrinops* using reference samples stored in GenBank (Tanaka & Ito 2020).

1.5 Conservation status

Twenty species of *Aquilaria* have been assessed for the IUCN Red List, of which 13 (65%) are considered threatened, with the remaining seven species assessed as Data Deficient (IUCN 2022) (see Annex 1 of the CoP19 information document on agarwood). Four species are assessed as Critically Endangered (*A. crassna*, *A. khasiana*, *A. malaccensis* and *A. rostrata*), one species as Endangered (*A. microcarpa*) and eight species as Vulnerable (*A. banaensis*, *A. beccariana*, *A. cumingiana*, *A. hirta*, *A. filaria*, *A. rugosa*, *A. sinensis* and *A. yunnanensis*). The seven species assessed as Data Deficient are due to a lack of up-to-date distribution, population and threat information. Assessments of the *Aquilaria* species were completed in 2017 and published in 2018.

The majority of *Aquilaria* Red List assessments note a continuing population decline for the species. This is due to exploitation for agarwood, which is the primary threat for several species (López-Sampson & Page 2018) and due to forest loss throughout the distribution range of the genus. Due to the high value of agarwood, buyers are actively looking for areas with remaining wild trees to ensure they have stock available, leaving protected areas the only remaining sites with agarwood trees left (UNODC 2016). Even in protected areas agarwood has been reported to be illegally harvested in some range States (TRAFFIC 2022a).

All species of *Gyrinops* have been assessed as threatened (IUCN 2022). Four species are assessed as Vulnerable (*G.caudata*, *G.podocarpa*, *G.versteegii* and *G.walla*) and four species are assessed as Endangered (*G.decipiens*, *G.ledermannii*, *G.moluccana* and *G.salicifolia*). The remaining species, *G.vidalii*, is assessed as Critically Endangered. Species of *Gyrinops* have small ranges, often being native to just one or two countries and are represented by very few herbarium records.

Owing to small geographic ranges, the majority of species are assessed under IUCN Red List Criterion B (small population sizes and continuing decline) (IUCN 2012). Despite the occurrence in trade of *Gyrinops* most species lack population information, in terms of size or extent of decline. Only two species, *G.ledermannii* and *G.walla* are assessed under Criterion A, with predicted population decline to exceed 50% and 30% respectively over the next 100 years (IUCN 2012). Population size is only known for *G.vidalii* which has less than 50 mature individuals surviving in the wild, causing its assessment as Critically Endangered.

All *Gyrinops* assessments cite the greatest threat to the species is over harvesting and excessive cutting for agarwood. The continuing high, international demand for agarwood means threats to *Gyrinops* remain despite their increasing rarity. The decline in wild populations of *Gyrinops* is compounded by the occurrence of the species in threatened lowland habitats across Southeast Asia and into Papua New Guinea which are at risk from conversion to agriculture (shifting agriculture and plantations) and infrastructure, as well as declining forest quality due to timber harvest.

1.6 International trade

In the last ten years (2011-2020) the majority of international trade of *Aquilaria* and *Gyrinops* recorded in the CITES trade database (CITES 2021a) has been in *A.crassna*, *A.filaria* and *A.malaccensis* with very small amounts of trade of *A.acuminata*, *A.beccariana*, *A.microcarpa*, *A.sinensis*, *A.subintegra*, *Gyrinops caudata*, *G.ledermannii*, *G.versteegii* and *G.walla* (see Annex 2, Figure 1 of the CoP19 information document on agarwood). Due to the difficulties in identification of *Aquilaria* and *Gyrinops* species (Gasson 2011) 12% of all *Aquilaria* trade records were reported as "*Aquilaria* spp." and 52% of all *Gyrinops* records were reported as "*Gyrinops* spp." (CITES 2021a). However, as some countries have reservations for *Aquilaria* and *Gyrinops* the CITES trade database does not contain complete data for all international trade for these species, making an overall analysis of trade not possible.

Between 2011 and 2020, 26 types of *Aquilaria* and *Gyrinops* commodities were recorded in international trade. The most common was wood chips (43%), followed by oils and extracts (27%), timber (including logs) (11%) and powder (8%) (CITES 2021a) (see Annex 2, Figure 2 of the CoP19 information document on agarwood). Finished *Aquilaria* and *Gyrinops* products are exempt from CITES regulations and are not included within the CITES trade database, but they are also traded internationally and domestically (Barden et al. 2000). The main CITES purpose code for use of *Aquilaria* and *Gyrinops* was for commercial purposes (96%), followed by personnel use (3%) with a few records for education, law enforcement, medical, travelling exhibition or scientific purposes (CITES 2021a).

Over 70% of *Gyrinops* trade records were recorded as sourced from the wild with 4% from cultivated sources (known as artificially propagated in CITES terminology). Source of *Aquilaria*, were more evenly divided with 42% from the wild and 50% artificially propagated (see Annex 2, Figures 3 & 4 of the CoP19 information document on agarwood). A small number of products traded were recorded as pre-convention, most of these records were for *A.filaria* and *A.malaccensis*. Seizure data was recorded in the CITES trade database, but this was mostly reported from the USA and Saudi Arabia and is suspected to be an underestimate of the products seized by CITES Parties. Seizure data would include agarwood items missing CITES permit paperwork as well as purposeful concealment and illegal trade.

Aquilaria and *Gyrinops* have been imported by 39 countries with Singapore, Saudi Arabia, United Arab Emirates, Japan and Kuwait the top five importers according to data recorded by importers (CITES 2021a) (see Annex 2, Figure 5 of the CoP19 information document on agarwood). Many agarwood products are exported from their country of origin through one or more countries before they reach the final consumer (Antonopoulou et al. 2010). Although Singapore, Saudi Arabia and United Arab Emirates are recorded as the most frequent importers, many of these shipments are then re-exported to other countries in their original form or processed into products ready for consumers (Barden et al. 2000; Chhipa et al. 2017). Singapore, Bangkok and Hong Kong have been reported to be the main trade hubs for buying and selling agarwood (Compton & Ishihara 2004; Antonopoulou et al. 2010).

The main countries of origin of *Aquilaria* and *Gyrinops* products reported by importers were Indonesia, Thailand, Malaysia, Vietnam, Laos, Bangladesh, Singapore, India and Papua New Guinea (CITES 2021a) (see Annex 2, Figure 6 of the CoP19 information document on agarwood). Over 200 records were recorded from an "unknown" country of origin, possibly due to problems recording data, particularly for products which are exported through multiple countries before reaching the final consumers. Singapore is within the top ten countries of origin

according to the CITES trade database data but this may be due to mis-recording as Singapore re-exports most of its agarwood, sometimes after processing into products ready to sell (Barden et al. 2000).

1.7 Illegal trade

Despite various national and international protections, the illegal harvesting and trade of *Aquilaria* and *Gyrinops* have been ongoing, driven by the high prices and demand for agarwood products. The first records of illegal harvesting were documented over 100 years ago, with records of illicit felling of agarwood recorded in India in 1905 (Chakrabarty et al. 1994). Illegal harvesting remains a serious issue, sometimes with foreign collectors illegally harvesting. In Malaysia illegal harvesting has been reported in National Parks and forest reserves, with some harvesters coming from neighbouring countries (Chua 2008; TRAFFIC 2022b).

In 2002 illegal harvesting and/or trade was reported in India, Indonesia, Lao PDR, Malaysia, Myanmar, Papua New Guinea and Vietnam (Barden et al. 2000). The greatest volumes of seizures of illegal agarwood were reported in 2016 to originate from Indonesia and Malaysia, with Saudi Arabia and the United Arab Emirates the highest reported destinations for seized material (UNODC 2016). Between 2005 and 2014, 230 seizure records totaling 35 metric tons of agarwood seizures were recorded on World WISE, which is estimated to have been harvested from up to 70,000 trees (UNODC 2016). Agarwood chips, powder, oil and beads were the most common products seized (UNODC 2016; TRAFFIC 2022a).

There has been a reported decrease in seizures of agarwood shipments in recent years; between 2009 and 2013, agarwood represented 4% of total wildlife seizures by monetary value, but between 2014 and 2018 agarwood seizures had a sharp relative decline to 0.6% of total seizures (UNODC 2020). Although this is a large decrease, agarwood remains the second most seized plant group after rosewoods (UNODC 2020). Agarwood seizures account for approximately half a percent of the volume of legal trade, it is suspected only a small number of seizures are detected and seizure data between years is volatile (UNODC 2016).

International trade of agarwood via postal mail or through airports can be difficult to detect by CITES and customs authorities and are favoured by illegal traffickers. Nevertheless, interceptions are regularly made, with postal supply chains and airports the most frequently recorded locations for plant seizures in the European Union in 2020 (TRAFFIC 2022b). Similarly, regular reports of agarwood seizures in Asia were recorded in postal mail and at airports (TRAFFIC 2022b).

Despite the declining trend in agarwood seizures recorded by UNODC (2020), between 2019 and 2020, the European Union recorded an increase in seizures of medicinal products, due to an increase in the use of herbal medicines triggered by the COVID-19 pandemic (TRAFFIC 2022b). This included agarwood products, with the United Kingdom reporting 168 seizures of medicinal or health products containing *Aquilaria* in 2019 to 2021 (JNCC 2022).

2. History of CITES and agarwood

The CITES website (www.cites.org) contains over 200 documents about agarwood. We searched through all Conference of the Parties (CoP) and Plant Committee (PC) documents and minutes for any discussions of *Aquilaria* and *Gyrinops* to produce a summary of all the main decisions and reports about agarwood from 1994 to the present day. Annexes 1-3 of the CoP19 information document on agarwood present the history of annotations for *Aquilaria* and *Gyrinops*, country quotas and country conservation management legislation.

2.1 Years 1994-1999

The first mention of agarwood and CITES was in 1994 at CoP9 when India proposed to include *Aquilaria malaccensis* on Appendix II because of concerns the species was overexploited due to the demand for agarwood (CITES 1994). This proposal was accepted, and the listing took effect from 16th February 1995, under annotation #1 (see Annex 1 of the CoP19 information document on agarwood).

In the years after *A. malaccensis* was listed, many reviews and reports were undertaken to understand its trade and use. At the 36th Meeting of the Standing Committee (SC) in 1996 (CITES 1997) it was proposed and approved that the German Scientific Authority, IUCN/SSC Medicinal Plants Specialist Group and TRAFFIC would analyse the trade in medicinal plants in Europe, including *A. malaccensis*. The Plants Committee (PC) considered a review of *A. malaccensis* was a priority and its inclusion in a Review of Significant Trade (RST) in Plants 1998-2000 was proposed at CoP10 in 1997 (CITES 1999). TRAFFIC Southeast Asia, TRAFFIC India and TRAFFIC International were contracted to research the status and trade patterns of *A. malaccensis* (CITES 1997), with the focus initially on the implementation of CITES, but later broadening to include agarwood use and trade (Barden

et al. 2000). The review was presented at PC9 in 1999 and identified that the reporting of trade for *A. malaccensis* was very inconsistent (CITES 1999), mostly due to the difficulty in differentiating between agarwood species. The Medicinal Plants Significant Trade Study was also presented at PC9 and identified the medicinal uses of *A. malaccensis*. The report found the 1995 listing of *A. malaccensis* had been anticipated by some traders, who created stockpiles of pre-convention material before the listing came into effect (Shippman 2020).

2.2 Years 2000-2009

At CoP11 in 2000 it was recognised that *Aquilaria* species are difficult to differentiate, and Decision 11.112 was made and directed to PC to continue the review of *Aquilaria*, determine how to distinguish the differences between different *Aquilaria* species, establish how to improve accurate reporting, and whether other species within the genus should be included in Appendix II (CITES 2000). It was recognised at PC12 in 2002, that five genera produced agarwood: *Aquilaria*, *Aetoxylon*, *Gyrinops*, *Phaleria* and *Gonystylus* (CITES 2002a), but only *A. malaccensis* was listed on Appendix II at this time. In 2001, a pilot project was established by the CITES Secretariat with the National Herbarium in the Netherlands, to investigate whether DNA markers could be used for species identification (CITES 2001).

At CoP12 in 2002, Decision 12.66 stated that the DNA work should continue with the aim of developing a method to identify agarwood species using molecular analysis (CITES 2002b). The Decisions also requested more information on *Aquilaria* species, including species distributions, the trade dynamics of importing and exporting countries, and a re-evaluation of the species conservation status by the IUCN. Decision 12.68 stated “studies should include all known agarwood-producing taxa and not only the CITES-listed species *A. malaccensis*” (CITES 2002b). The initial pilot study in 2001 demonstrated that molecular analysis could potentially determine the species in trade, although in 2004 there had been no further progress on the work (CITES 2004b). At CoP13 discussions on identification of agarwood continued, Decision 13.61 made as a repeat of Decision 12.66, stating DNA work should continue. A second pilot study was carried out in 2005 with the objectives; to identify markers to differentiate between wild and cultivated agarwood, develop a molecular tool to identify species of agarwood, and to genotype *A. crassna* and *A. malaccensis* from plantations in provinces within Southeast Asia (CITES 2006). Results were published at PC16 in 2006 and determined that it may be possible to genetically differentiate between plantations and it would be possible to develop a molecular-based tool to identify agarwood species.

Growing concerns over agarwood trade at PC12 (2002) resulted in *A. malaccensis* being suggested for review under the Review of Significant Trade which subsequently became Decision 12.74 at CoP12. TRAFFIC Southeast Asia undertook the investigation into trade dynamics and identified Indonesia and Malaysia as the major exporters of agarwood, Singapore and Taiwan as major re-exporting and consuming countries, and Japan, Saudi Arabia and the UAE as major importing countries (CITES 2003b).

The first international agarwood conference was held in Ho Chi Minh City and An Giang Province in Vietnam from 10-15 November 2003 (see Annex 3 of the CoP19 information document on agarwood). This was the first major conference about agarwood and was timely, as it had been noted at PC13 (2003) that the quantity and quality of agarwood in Papua New Guinea had been declining, and traders were looking for new sources (CITES 2003a).

At CoP13 in 2004, Indonesia proposed to include all *Aquilaria*, *Gyrinops* and *Gonystylus* species in Appendix II (CITES 2004a) with annotation #1 ((see Annex 4 of the CoP19 information document on agarwood) (CITES 2004b). It was argued that as it is hard to differentiate between *Aquilaria* and *Gyrinops* species once they are traded as wood chips, oils or powder, and with only *A. malaccensis* listed on Appendix II this could lead to detrimental effects on look-a-like agarwood species (Soehartono 2002). The proposal was adopted and took effect on 12th January 2005 leading to a significant shift in the sustainable trade of agarwood.

The Review of Significant Trade for *Aquilaria malaccensis* (CITES 2003b) was published in 2003 and presented in 2004 at PC14. It identified that range States differed slightly from those listed previously in The World List of Threatened Trees (Oldfield et al. 1998) as *A. malaccensis* does not occur in Iran (CITES 2003c). The review summarised conservation and management of the species in its range States, which included a total protection under forest laws in Bhutan, Myanmar, Philippines, Singapore and Thailand, and an export ban of products from India (CITES 2003c) (see Annex 3 of the CoP19 information document on agarwood). Indonesia produced a report on the ‘Procedure to Make Non-Detriment Findings for the Trade in *A. malaccensis* and Other Agarwood-producing Species in Indonesia’ in accordance with the Review of Significant Trade (CITES 2005).

During this decade many reports on agarwood trade and use were written by TRAFFIC and range and consumer CITES parties. Reports on trade and use in Japan and Taiwan were presented at PC15 (2005) and a report on agarwood and trade in the United Arab Emirates was presented at CoP15 in 2010. Whilst Taiwan is not a Party of CITES, it does implement CITES regulations through its domestic regulation and according to the RST on *A.*

malaccensis, Taiwan is a major market for agarwood (CITES 2003c). These documents were produced to fulfil Decision 12.71 from CoP12 on further field research in trade dynamics of agarwood.

In 2005, the United Arab Emirates, Syrian Arab Republic, Kuwait and Qatar all entered a reservation for *Aquilaria* spp. and *Gyrinops* spp, but the reservation does not include *A. malaccensis* (UNEP-WCMC 2022b, a). These reservations are still in place in 2022. This has resulted in little reported trade in Parties with a reservation, making it extremely difficult to monitor quotas (see Annex 5 of the CoP19 information document on agarwood), global trade and trace supply chains. In 2013, Canada entered a reservation for *Aquilaria* spp. and *Gyrinops* spp., this was rescinded in 2015 for both genera (UNEP-WCMC 2022b, a).

Three agarwood workshops occurred between 2005 and 2006 in Indonesia and Malaysia to discuss agarwood trade (see Annex 3 of the CoP19 information document on agarwood). Firstly a National Seminar on agarwood was held on the 1st and 2nd December 2005, on the 'Opportunity, challenge on agarwood development in Indonesia' and was conducted by SEAMEO Biotrop (The Regional Centre for Tropical Biology of Southeast Asian Ministers of Education Organization) in Bogor, Indonesia (CITES 2006). Secondly a workshop on 1st and 2nd March 2006 on the trade dynamics of agarwood in Malaysia and considerations of CITES NDFs conducted by TRAFFIC Southeast Asia in collaboration with Forest Research Institute Malaysia and the Ministry of Natural Resources and Environment (the CITES Scientific Authority in Malaysia) (CITES 2006; Wyn & Anak 2010). This workshop presented initial findings by TRAFFIC on agarwood trade dynamics in Malaysia which had investigated trade chains and undertaken surveys and semi-structured interviews with agarwood product retailers (Wyn & Anak 2010). Lastly, an Experts Group Meeting on agarwood, focussed on capacity-building and improving implementation and enforcement of *A. malaccensis*, which was held 14th-17th November 2006 in Kuala Lumpur, Malaysia, and organised by TRAFFIC Southeast Asia together with the Malaysian Government (TRAFFIC 2007). The experts meeting was organised in response to Decision 13.65 from CoP13 which directed Parties to work on capacity building to aid in enforcement and implementation of agarwood (TRAFFIC 2007).

The second international conference on agarwood was held 4th-11th March 2007 in Bangkok, Thailand (see Figure 7 of the CoP19 information document on agarwood). Brunei Darussalam was a participant at this conference in which it was agreed within Brunei there should not be a trade ban for agarwood perfume, oil, chips and seedlings for research, however there would still be a ban on trade of logs (CITES 2009b). It was reported that illegal harvest and trade of *A. malaccensis* and *A. beccariana* do occur in Brunei but is monitored closely by enforcement agencies (CITES 2003b).

Agarwood discussions continued at CoP14 in 2007 with many Decisions for agarwood-producing taxa directed to Parties and the CITES Secretariat. These included producing identification materials for all forms of traded products, Parties identifying, agreeing products and quantities that could be exempt for the future amendment of annotation #1, and production of an agarwood glossary with definitions, which was subsequently adopted at PC20 in 2012 and is available at CoP16 Inf. 3 (CITES 2013a). Decisions were directed to PC and the Secretariat to develop criteria and principles for forming NDFs for agarwood producing species (CITES 2007).

At PC17 (2008), discussion of annotation #1 continued with an intersessional working group (CITES 2008b) on agarwood-producing species discussing the potential of merging annotation #1 and #4 to help define what products were controlled by trade and trade reporting (CITES 2008a). Singapore expressed that annotation #1 for *Aquilaria* spp. did not include an exemption for finished products and those ready for retail.

Additionally, at PC17 (2008), NDF's were discussed as an issue for range States, as it was difficult to report trade of agarwood when it came from mixed sources. TRAFFIC drafted a methodology for NDFs for agarwood-producing species (TRAFFIC 2008) and Mexico organised an International Experts Workshop on NDF methodology in Cancun from 17th-22nd November 2008. This workshop established four working groups and working group one (Trees) and two (Perennial plants) discussed NDFs for agarwood-producing species (CITES 2009a). The workshop report was presented at PC18 (2009), which includes the process for making an NDF. A draft decision was proposed to be put forward at CoP15, directed to PC to consider the current definition of artificially propagated plants and how it is applied to mixed tree plantations, which became decision 15.94.

2.3 Years 2010-2019

At Cop15 in 2010 proposal 25 was put forward to delete annotations #1 and #4 and replace these with a new #4 (see Annex 1 of the CoP19 information document on agarwood) (CITES 2010), which was adopted for all agarwood species listed in Appendix II. This new annotation still did not include any specifics regarding agarwood or any exemptions for finished products. Decisions 15.26 and 15.27 made at CoP15 (CITES 2013c) included inviting Parties to conduct workshops on NDF guidance for *Prunus africana*, medicinal plants and agarwood-producing species. Three workshops were held in 2011 (see Annex 3 of the CoP19 information document on agarwood); a capacity-building workshop on NDFs and a review of significant trade of plant species in

Kathmandu, Nepal, 9th-11th January 2011, a workshop on the “Implementation of CITES for agarwood-producing species” in Kuwait from 3rd-6th October 2011 (CITES 2012a), and finally, an Asian regional workshop on “Agarwood: management of wild and plantation-grown agarwood”, held in Bangka Tengah, Indonesia from 22nd-25th November 2011 (CITES 2012b).

Agarwood was discussed again at CoP16 in 2013, which resulted in many changes to CITES regulations of *Aquilaria* and *Gyrinops*. Firstly, Prop. 70 was put forward to delete the annotation for *Gyrinops* spp. and *Aquilaria* spp. and replace it with a new annotation #14. This annotation included exemptions for personal effects, initially when submitted by China, Kuwait and Indonesia, the proposal also included a section on the percentage of agarwood that oil could contain. Due to the difficulties in determining the percentage of agarwood contained in oils when in trade, this was excluded when CoP16 adopted the new annotation #14 (see Annex 1 of the CoP19 information document on agarwood) (CITES 2015a).

Proposed guidance for making NDFs for agarwood producing species was published at CoP16 (agreed upon at PC20). The document (CITES 2013b) was prepared as a result of Decision 15.94 and details the criteria should be applied for wild-sourced and plantation-sourced agarwood (CITES 2013c).

Resolution Conf. 16.10 was adopted at CoP16 on the implementation of the Convention for agarwood-producing taxa, and the PC were directed to monitor this implementation. Resolution Conf. 16.10 was implemented due to agarwood being classed as a non-timber forest product. As agarwood is cultivated and is different to conventional forestry, the CITES definitions for artificially propagated were insufficient (CITES 2021c), due to the scope of the term ‘grown under controlled conditions’ (CITES 2013d). A new definition for ‘under controlled conditions’ was adopted for agarwood-producing taxa, defined as meaning “in a tree plantation, including other non-natural environment, that is manipulated by intervention for the purpose of producing plants or plant parts and derivatives” (CITES 2013d). The term ‘artificially propagated’ was also interpreted for agarwood, stating agarwood-producing taxa must be “a) grown under controlled conditions and b) grown from seeds, seedlings, saplings, cuttings, grafting, marcotting/air-layering, divisions, plant tissues or other propagules that have been derived from wild or cultivated parental stocks, according to the definition of ‘cultivated parental stock’ in Resolution Conf. 11.11 (Rev. CoP18)” (CITES 2013c). The Resolution details management and control of agarwood-producing species and encourages Parties to try and establish a registration system for specimens produced by artificial propagation and for those Parties that export agarwood oil (CITES 2013d).

India and Thailand submitted a glossary of agarwood products at PC21 in 2014, and the agarwood working group was directed to improve upon and present the final glossary at PC22 (2015). Kuwait and China subsequently updated the glossary, and it was made available to Parties in hard and electronic copy at CoP17 in 2016 (CITES 2016b). At PC21, Indonesia detailed the publication of an orchid, fern and agarwood guidebook, as well as producing a guide on managing agarwood plantations and the development of a registration system (CITES 2014).

An Asian regional workshop was held 19th– 23rd January 2015 in Guwahati, Assam, India. This workshop on the management of wild and planted agarwood taxa was held to aid in the management and conservation of agarwood producing species, formulation of NDFs and to aid in communication between Parties. This workshop detailed the development of registration processes in range States that cultivate *Aquilaria* spp. and *Gyrinops* spp., including Thailand and Malaysia (CITES 2015b). The second Asian regional workshop, following on from the first agarwood workshop in 2011, was held three years later in Yogyakarta, Indonesia from 25th-29th June 2018 for the management of wild and planted agarwood taxa. It was hosted by the Indonesian Ministry of Forestry, along with the International Tropical Timber Organisation (ITTO), through the CITES Tree Species Programme (CITES 2018c). This workshop was organised following Decision 17.197 at CoP 17 in 2016 to bring together range States and improve capacity building (CITES 2018b). The workshop discussed the trends in agarwood trade as well as how to aid the long-term survival of wild populations through plantation programmes in each of the range States (CITES 2018a).

The United States submitted a proposal at CoP17 (2016) (CITES 2016a) to amend annotation #14 for *Aquilaria* spp. and *Gyrinops* spp. to include exemptions for the following agarwood items when transported as personal effects; 1kg of wood chips, 24ml of oil and two sets of beads or prayer beads (or two necklaces or bracelets) per person (Shippman 2020). It was noted at SC66 in 2016 the term ‘exhausted’ should continue to be included in the annotation, as it is a term used in the industry to determine if agarwood powder has had the oil extracted or not (CITES 2016b).

Parties continued to work on improving the conservation of *Aquilaria*, and in 2017 at PC23, Indonesia reported they had implemented a registration system for plantation agarwood, through the Director General Regulation, which was enacted in 2018 (CITES 2017). At PC24 in 2018, Malaysia detailed the implementation of a new

project on the conservation of *A. malaccensis* to try to reduce the pressure on wild populations under the CITES tree species programme (CITES 2018c).

2.4 Years 2020-2022

In 2019 a draft decision 18.AA (CoP18 Doc. 65) was directed to PC to monitor the implementation of Res. Conf. 16.10 by examining trade data and analysing the conservation status and impacts of agarwood-producing taxa using the available data. The PC were asked to develop a questionnaire, which was later sent to the Parties as a notification (No. 2020/022), and to analyse the responses. Using the outcome of the analysis, areas in need of further assessment of conservation impacts would be identified and the findings presented at CoP19 in 2022 (CITES 2018c). Eight Parties responded to the questionnaire: Bhutan, Cambodia, China, Germany, the Philippines, Switzerland, Thailand and the United States of America (CITES 2020b). The main findings of the questionnaire were presented at PC25 (CITES 2020b) and identified most of the seeds or propagules for agarwood-producing species were obtained from parental stock found in home gardens or plantations, and were planted within monospecific plantations or mixed plantations. No Party reported that they use the agarwood NDF guidance.

The annotations working group was re-established at SC72 in 2019, to continue to review the current annotations to the Appendices including those for *Aquilaria* spp. and *Gyrinops* spp. (CITES 2020a).

PC25 in 2021 was held online due to the COVID-19 pandemic, and it was recommended by the agarwood working group to postpone any revisions to Resolution Conf. 16.10, along with any potential revisions to the glossary and NDF guidance (CITES 2021b). The in-session agarwood working group recommended there was a need for further guidance and capacity building on legal acquisition findings, as well as more information on chain of custody and made three draft decisions directed to PC. The agarwood working group had concerns regarding the methodologies used to produce agarwood, as well as the use of different source codes (CITES 2021b). The CITES Secretariat and the ITTO are currently implementing a study on agarwood which will be presented at CoP19 to help aid in addressing those concerns (CITES 2021b, c).

2.5 Quotas

Many range States have quotas for *Aquilaria* and/or *Gyrinops* which are detailed in Annex 5 to the CoP19 information document on agarwood. All *Gyrinops* spp. had quotas from Indonesia from 2008-2016. *G. decipiens* had an additional quota for 2020, and *G. versteegii* had additional quotas from 2005- 2007 and 2017-2021. In 2007, Indonesia had a stockpile of *G. versteegii* and *A. filaria*. *A. crassna* was the only species of *Aquilaria* to have a quota in Lao PDR, and the only species to have quotas in litres for oil, and meters cubed for sawn logs. Quotas for *A. beccariana*, *A. cumingiana*, *A. filaria*, *A. hirta*, *A. malaccensis*, *A. microcarpa*, *A. moszkowskii*, *A. secunda* and *A. tomentosa* had the same quotas from 2007- 2016 for Indonesia. From 2012-2022, quotas for *A. beccariana*, *A. filaria*, *A. hirta*, *A. microcarpa* and *A. rostrata* in Malaysia (Sarawak) remained the same. *A. khasiana* and *A. malaccensis* had additional quotas for India. *A. malaccensis* had additional quotas before 2007 and after 2017 from Indonesia in addition to having a higher quota from Malaysia. *A. filaria* had additional quotas due to stockpiles and combination quotas with *G. versteegii*.

2.6 Conservation management legislation for agarwood

An online literature search for documents on national legislation on agarwood in range States was undertaken and is available in Annex 6 of the CoP19 information document on agarwood. Only documents in English were included in the search but we acknowledge that range States may have other documentation not available on the internet, or in another language.

3. Recommendations

From this review of the history of agarwood in CITES, several topics have been discussed repeatedly or identified as areas which cause difficulties for range States or consumer Parties in helping to support the sustainable trade of agarwood. These topics are presented below, with recommendations for future research and actions to help solve some of the most challenging areas in agarwood CITES implementation. They are in no particular order, but we hope they will provide ideas for future agarwood discussions, workshops and projects. Some recommendations are similar to those identified by the PC25 in session agarwood working group and the draft decisions directed to the PC in PC25 Com 7 (CITES 2021b). Reference should also be made to the recommendations in the ITTO agarwood report to be presented at CoP19.

3.1 Taxonomy:

- a) Clarify generic and species limits for *Aquilaria* and *Gyrinops* with a molecular phylogenetic study using Next Generation Sequencing Techniques.
- b) Review the standard CITES nomenclature for *Aquilaria* and *Gyrinops*.

3.2 Identification:

- a) Develop a standard reference collection of wood and oil samples of all *Aquilaria* and *Gyrinops* species from range States. This will be essential to aid the development of molecular and chemical identification techniques. This would contribute to recommendation 5 identified in PC25 Com 7 (CITES 2021b).
- b) Identify the availability and location of practical tools and techniques for custom officers to accurately identify agarwood products at country borders. This would contribute to recommendation 5 identified in PC25 Com 7 (CITES 2021b).
- c) Study the production methods of agarwood oils and perfumes to examine if the mixing of agarwood oil with other oils occurs, and which other plant species are used. This could lead to studies to determine what percentage of agarwood oil is in mixed oils and the implications this has for accurate reporting of range States quotas for agarwood. This would contribute to recommendation 5 identified in PC25 Com 7 (CITES 2021b).

3.3 Conservation:

- a) Survey the size and status of wild populations of agarwood species to aid NDFs and IUCN Red List reassessments, particularly for *Aquilaria* species assessed as Data Deficient and to identify those species threatened by population decline. This would contribute to the work required for draft Decision 19.AA b in PC25 Com 7 (CITES 2021b).
- b) Determine through research whether an App II listing is merited for *Aetoxylon sympetalum*. Investigate wild population status and trade to discover if it is threatened by international trade and its similarity to *Aquilaria* species.

3.4 Legislation and trade:

- a) Further develop the Agarwood CITES glossary (CITES 2013c) to include more detailed definitions of agarwood products to aid customs officers, for example, exact measurements of chips and powder and defining the percentage oil content of exhausted and non-exhausted powder. This would contribute to the work required for Decision 19.AA b) in PC25 Com 7 (CITES 2021b).
- b) Enable and streamline knowledge sharing through workshops and online forums, to improve yields and quality of cultivated agarwood as well as to examine sustainable harvesting techniques for cultivated and wild agarwood.
- c) Survey range States of *Aquilaria* and *Gyrinops* to understand how the species are protected within each Parties national legislation. This would contribute to recommendation 5 identified in PC25 Com 7 (CITES 2021b).

TENTATIVE BUDGET AND SOURCE OF FUNDING FOR THE IMPLEMENTATION OF DRAFT RESOLUTIONS OR DECISIONS

According to Resolution Conf. 4.6 (Rev. CoP18) on *Submission of draft resolutions, draft decisions and other documents for meetings of the Conference of the Parties*, the Conference of the Parties decided that any draft resolutions or decisions submitted for consideration at a meeting of the Conference of the Parties that have budgetary and workload implications for the Secretariat or permanent committees must contain or be accompanied by a budget for the work involved and an indication of the source of funding.

In order to inform discussions, tentative costs for the implementation for some of the recommendations in this document are presented below.

A phylogenetic study of the genera *Aquilaria* and *Gyrinops* leading to revisions of the standard CITES nomenclature (recommendations i and ii) may cost around USD 350,000 to 400,000 as would need to include fieldwork and laboratory work.

Literature research studies costing around USD 40,000 each could be undertaken to fulfil some recommendations (iv., vii, ix, and x).

International workshops could be undertaken to discuss recommendation viii to develop the glossary and ix to share knowledge on cultivation of agarwood and sustainable harvesting. These workshops could involve over 50 participants from across the range States and consumer countries involving significant travel costs. Meetings of that size and nature carry an approximate cost of between USD 100,000 to 200,000.

Developing a standard reference collection for *Aquilaria* and *Gyrinops* (recommendation iii) could occur in partnership with the World Forest ID programme. Their project budgets USD 100 per sample, a comprehensive collection of *Aquilaria* and *Gyrinops* could cost around USD 30,000. A study to determine the mixing of agarwood oils and percentage of oil in exhausted and non-exhausted powders (recommendations v and viii respectively) would cost USD 100,000 for laboratory analysis.

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