CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Inclusion of *Guaiacum* spp. in Appendix II in accordance with Article II, paragraph 2(b).

Annotation: Designates all parts and derivatives, including wood, bark and extract

B. Proponent

Germany (on behalf of the member states of European Community).

C. Supporting statement

1. Taxonomy

1.0	Division:	Magnoliophyta
1.1	Class:	Magnoliopsida
1.2	Order:	Sapindales
1.3	Family:	Zygophyllaceae
1.4	Genus:	*Guaiacum* L.
1.5	Species:	*Guaiacum angustifolium* Engelm. *Guaiacum coulteri* A. Gray *Guaiacum guatemalense* Planch. ex Vail & Rydberg *Guaiacum officinale* L. (CITES App. II) *Guaiacum sanctum* L. (CITES App. II) *Guaiacum unijugum* T.S. Brandegee
1.6	Scientific synonyms:	*G. bijugum* Stokes (synonymof G. officinale) *Guaiacum multijugum* Stokes (synonym of G. sanctum) *Guaiacum planchonii* A. Gray ex Vail & Rydberg (synonym of G. coulteri) *Guaiacum palmeri* Vail (synonym of G. coulteri var. palmeri) *Guaiacum parvifolium* Planch. ex A.Gray (synonym of G. coulteri) *Guaiacum sloanei* Shuttl. ex A. Gray (synonym of G. sanctum) *Guaiacum verticale* Orteg. (synonym of G. sanctum) *Porliera angustifolia* Engelm. (synonym of G. angustifolium)
1.7	Common names:	English: Sonora guaiacum, lignum-vitae, pockwood, wood of life, tree of life French: bois de gaïac, bois de vie, bois saint, gaïac, gayac Spanish: guayacán, guajacum, leño de guayaco, palosanto, trimarindillo Aztec: matlalquauitl German: Pockholz, Guaiacum Portuguese: guaiaco, pau santo, lenha di guaiaco
1.8	Code numbers:	

2. Biological parameters

The genus *Guaiacum* consists of 4-6 different species of New World evergreen trees and shrubs distributed throughout Mesoamerica and the Caribbean (MARYLAND-REPORT 2000; GROW & SCHWARTZMAN 2001). The current taxonomy of the different *Guaiacum* species is still not unanimously accepted.

Apart from *G. sanctum* and *G. officinale*, four other *Guaiacum* species are described:

- *Guaiacum coulteri* is a small, neotropical, evergreen, and slow-growing tree or shrub and grows – under optimal conditions – up to about 4 meters in height. The age-size relationship in *G. coulteri* is unknown. It may also trail along the ground, under certain conditions (MARYLAND-REPORT 2000). *G. coulteri* prefers a fully sun-exposed or lightly shaded environment in dry forests to scrub. Flowers usually appear between April and September, are deep blue-violet and grow in clusters or solitary (MIELKE 1993). The heartwood is yellowish to olive brown, very hard, and heavier than water (MARYLAND-REPORT 2000, BMVEL, *in litt.*, May 2002).

- *G. unijugum*: endemic to SE Baja California (Mexico) (CITES COP 11, 2000).

- *G. angustifolium*: Native to the Southern Plains and Edwards Plateau (Texas, USA) and to northern Mexico (RESEARCH & EXTENSION CENTER VIRTUAL HERBARIUM, no date; GROW & SCHWARTZMAN 2001). Its taxonomy is still unclear (GROW & SCHWARTZMAN 2001) and it may be a synonym for *G. coulteri* (MARYLAND-REPORT 2000).

- *G. guatemalense*: is discussed as (1) a distinct species; (2) a synonym of *G. sanctum*; or (3) a hybrid of *G. sanctum* and *G. coulteri*; (CITES COP 8, 1992; CITES COP 11, 2000; GROW & SCHWARTZMAN 2001; BENÍTEZ DÍAZ, *in litt.*, June 2002).

The following features can be used to identify *G. sanctum* and *G. coulteri* **in the field** (MARYLAND-REPORT 2000):

Characteristic	***G. coulteri***	***G. sanctum***
Flower colour and shape	deep violet-blue; distinctly clawed petals	purple (can be lighter than *G. coulteri*)
Ovary	glabrous (smooth)	pubescent (hairy)
Leaflet shape	narrow, elliptical	oblong, ovate or lanceolate

Guaiacum species contains a number of substances which are or were used for medicinal purposes. Among these are a- and b-guaiaconic acids, guaiaretic acid, guaiacic acid, vanilin, guaiaca saponin and guaiaguttin (higher terpenoid) (HEALTHLINK, no date).

2.1 Distribution

G. coulteri is most likely endemic to **Mexico** (GROW & SCHWARTZMAN 2001). Its native distribution ranges from the states of Oaxaca to Sonora, Western Mexico (MIELKE 1993; GROW & SCHWARTZMAN 2001). *G. coulteri* populations predominantly occur between the coast and the foothills of the Sierra Madre Occidental (MARYLAND-REPORT 2000). The species is found in the states of Sonora (MIRANDA & ALCALÁ, 1989), Sinaloa (INSTITUTO NACIONAL DE ESTADISTICA, GEOGRAFIA E INFORMATICA, no date), Jalisco (CPD: MIDDLE AMERICA, no date) and Oaxaca (Huatalco Parque Nacional, INSTITUTO NACIONAL DE ECOLOGÍA, no date; SEMARNAT, no date), but populations are also reported from Yucatan (REUTER, *in litt.* to TRAFFIC Europe-Germany, February 2002).

It is still not finally determined if the range of *G. coulteri* var. *coulteri* extends southward into **Guatemala** (CITES COP 8, 1992; MARYLAND-REPORT 2000). If so, PORTER's (1972) interpretation

may be still valid considering *G. guatemalense* a hybrid form of *G. coulteri* and *G. sanctum*. The distribution of *G. coulteri* var. *palmeri* is most probably restricted to Northwest Mexico (Northwest Sonora to North Sinaloa) (WIGGINS 1964).

Outside of its native distribution, *G. coulteri* has naturalized in some southern states of the USA, where it is mainly used as an ornamental or horticultural plant (MARYLAND-REPORT 2000). *G. coulteri* is reported from the Phoenix area (DESERT TROPICALS, no date), from the University of Arizona campus (MARYLAND-REPORT, 2000) and from the Arizona part of the Sonoran desert in Southern Arizona (HONCOOP, 1997). No detailed information is available on individual, naturalized US-populations of *G. coulteri*, nor on their status and size.

Besides its occurrence in the wild, *G. coulteri* is also cultivated in Mexico (TODD, *in litt.*, February 1999).

G. angustifolium occurs in the **United States of America** (southern and western Texas) and in northeastern and north central **Mexico**.

G. unijugum is endemic to **Mexico** where it is restricted to the southeastern cape of Baja California. (MARYLAND-REPORT 2000; BENÍTEZ DÍAZ, *in litt.*, June 2002).

2.2 Habitat availability

The natural habitat of *G. coulteri* in Mexico has been reduced by land clearing and deforestation for agricultural purposes and by the introduction of non-native species like buffelgrass (*Pennisetum ciliare*). As *G. coulteri* is a slow-growing, endemic species with no apparent tendency to migrate, its available habitat decreases. Competition by faster growing tree species are reported to be a natural threat to populations of *G. coulteri* (MARYLAND-REPORT 2000). Therefore, protection and restoration of the potential habitat of *G. coulteri* is essential for an effective management (MARYLAND-REPORT 2000).

2.3 Population status

The information on both the size and the status of the population of *G. coulteri* in Mexico is incomplete. The species is reported to be widely distributed throughout its native range but not common. It may be locally abundant, but occurring at low densities (MARYLAND-REPORT, 2000). *G. coulteri* is exploited for local use and under pressure from land-uses that threaten the status and survival of wild populations. Information on the population status of *G. unijugum* is contradictory and no population information is available for *G. angustifolium*. (GROW & SCHWARTZMAN, 2001).

2.4 Population trends

There is no detailed information available, but populations in the wild are likely to decrease (see also 2.7): wild populations of the related species *G. sanctum* and *G. officinale* have declined due to collection of wild plants and the removal of the natural vegetation for agricultural purposes or developments for the tourism industry. With the documented decline in wild populations and existing CITES trade controls for both *G. sanctum* and *G. officinale*, collection and export of *G. coulteri* may be expanding and thus its population decreasing.

2.5 Geographic trends

No information available.

2.6 Role of the species in its ecosystem

Little is known about the role of *G. coulteri* in the ecosystem. The species is not dominant and wild populations consist of isolated individuals rather than concentrated stands of trees (MARYLAND-REPORT 2000). *G. coulteri* is an important food plant for various insects and their larvae in dry deciduous scrub forests (MARYLAND-REPORT 2000). The females of the lyside sulphur butterfly *Kricogonia lyside* prefer to deposit their eggs on the leaves of *G. coulteri*, the butterfly's common foodplant in Sonora (HONCOOP 1997). Additionally, plants provide shelter for invertebrates during the dry season (MARYLAND-REPORT 2000).

Birds may play an important role in the reproduction and distribution of *G. coulteri* by pollinating plants and dispersing seeds.

2.7 Threats

SEDESOL (1994) lists and defines *G. coulteri* as "species .....in danger of extinction, vulnerable species, rare species and species under special protection".

Preparing the land through habitat-conversion by burning or cutting down the natural vegetation, development of hotels and resorts, and logging pose a threat to *G. sanctum* and *G. coulteri* (GROW & SCHWARTZMAN 2001; CPD: MIDDLE AMERICA, no date). The introduction of non-native species contributes to these threats (MARYLAND-REPORT 2000; GROW & SCHWARTZMAN 2001). Populations of *G. coulteri* are reported to be especially affected by planting buffelgrass (*Pennisetum ciliare*) as cattle fodder after land-clearing: the grass changes the fire dynamics in the ecosystem exposing native species like *G. coulteri* to an increased threat from fire (MARYLAND-REPORT 2000). The most serious threat is deforestation, although it is unknown to what extent the wild populations of *G. sanctum* or *G. coulteri* in Mexico are affected (GROW & SCHWARTZMAN 2001).

G. coulteri is traded internationally (e.g., BARSCH *et al.* 2002; see 3.2) and may thus be subject to current and future increasingly intensive harvest as a substitute for *G. sanctum,* whose wild populations may be decreasing as a result of potential over-harvest for the trade (GROW & SCHWARTZMAN, 2001).

3. Utilization and trade

3.1 National utilization

Today, *Guaiacum* species are mainly used as timber. *Guaiacum* residual products used for other purposes are usually by-products of timber production (GROW & SCHWARTZMAN 2001; BENÍTEZ DÍAZ, *in litt.*, June 2002). The genus produces one of the heaviest commercial woods in trade. Guayacán timber is primarily used for mechanical devices in bearings and marine propeller shafts, but also in pulley sheaves, casters, bowling balls, handles and sheaths (GROW & SCHWARTZMAN 2001; WOODEX 2002; BENÍTEZ DÍAZ, *in litt.*, June 2002).

G. coulteri is harvested and marketed locally (reported from Jalisco, CPD MIDDLE AMERICA, no date), for firewood collection and as a speciality wood for handicrafts or ornamental purposes. This is believed to have a negligible impact on wild populations (MARYLAND-REPORT 2000). *G. coulteri* has been used locally as an expectorant and blood purifying medicine (GROW & SCHWARTZMAN 2001), as a mild laxative and diuretic or to treat rheumatoid arthritis (MARYLAND-REPORT 2000). The local and national medicinal markets for *Guaiacum spp.*, however, are nearly non-existent today.

The flowers of *G. coulteri* have been used to produce an intensive, organic blue colouring agent for painting (matlali) by the Aztecs (HAUDE 1998). Until recently, the Seri from Sonora used a mixture of the green, organic resin from *G. coulteri*, clay and water to produce the colouring agent antezj

kóil (Seri blue) (HAUDE 1998). There are no reports about a possible current use of the flowers or the resin of *G. coulteri* as a colouring agent.

The wood of *G. unijugum* is used in Mexico (MARYLAND-REPORT 2000).

G. angustifolium is known as 'soap-bush', because the bark of the roots can be used for producing soap. *G. angustifolium* is also regarded as a medicinal plant. Root extracts are used to treat rheumatism and syphilis (veneral disease) (RESEARCH & EXTENSION CENTER VIRTUAL HERBARIUM, no date).

3.2 Legal international trade

According to the MARYLAND-REPORT (2000), *Guaiacum* exports from Mexico have significantly declined in recent years due to a decreasing demand of *Guaiacum* timber for which substitutes are now available and increasingly used. Trade information provided by CONABIO and reported *G. sanctum* show a stable trade until 2001 when the Mexican export policy changed (Figure 1; BENÍTEZ DÍAZ , *in litt*., June 2002).

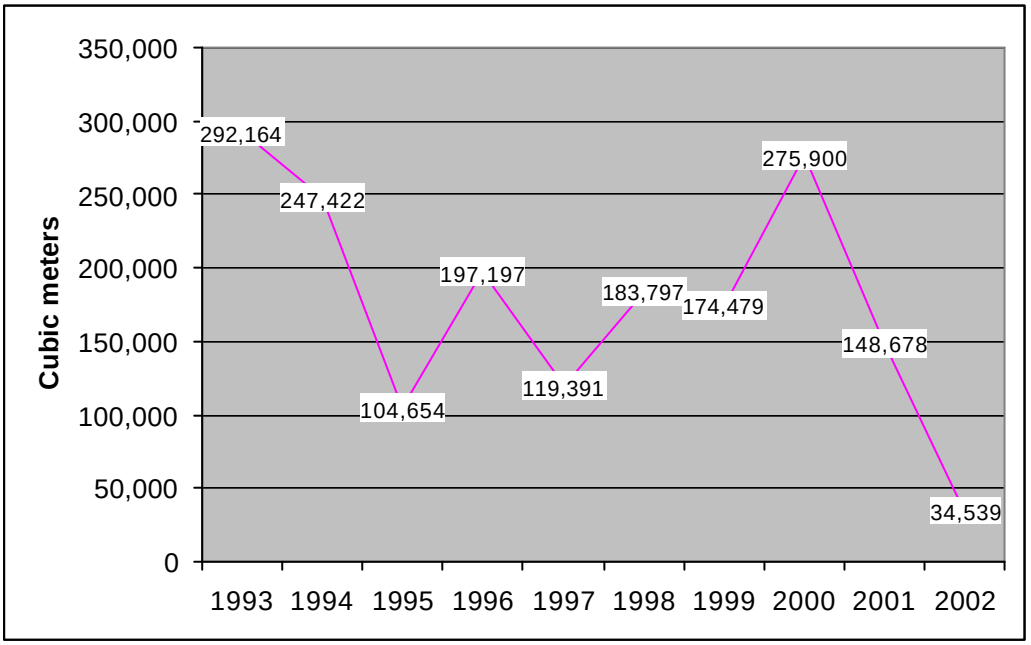

Figure 1: Exports of *Guaiacum sanctum* from Mexico. Unit: m^3. Source: CONABIO (BENÍTEZ DÍAZ, *in litt*., June 2002).

Trade data usually do not distinguish among *Guaiacum* species (MARYLAND-REPORT 2000). Exports from the Mexican west coast are most likely *G. coulteri*, although it remains unknown how much is exported, because precise trade statistics are not available and it is not possible to distinguish the wood of the different *Guaiacum* species.

The largest exporter of *Guaiacum* from Mexico is Transforesta, which claims responsibility for about 60% of all CITES authorized *Guaiacum* exports from Mexico between 1993 and 1998 (MARYLAND-REPORT 2000). The main markets for these exports are Asia and Europe. Only a relatively small portion is reported to be exported to the USA (MARYLAND-REPORT 2000).

G. coulteri has been exported to North America and Europe for medicinal use for centuries. There is, however, little clinical evidence of efficacy regarding the medicinal properties of *Guaiacum spp.* (GROW & SCHWARTZMAN 2001). Inconclusive evidence of the taxon's medicinal potential may have

resulted in declining demand and trade as a medicinal. Only one shipment of *Guaiacum* has reportedly entered international medicinal trade within the last 20 years (GROW & SCHWARTZMAN 2001; SCHIPPMANN 2001).

According to companies which import *Guaiacum* timber, Germany annually imports about 50 tons of *G. coulteri* for industrial hardwood applications (BARSCH *et al.* 2002). These companies estimate an additional annual amount of 20 to 40 tons of imported *Guaiacum* heart-wood resin and *Guaiacum* wooden chips that may exclusively be used as a natural aromatic substance by the liqueur industry. These imports consist largely or entirely of *G. coulteri* (BARSCH *et al.* 2002).

G. coulteri is also exported from Mexico to be used in ready-made diagnostic sets for detecting occult gastrointestinal bleeding. These sets contain the resin of the heart-wood of *G. coulteri.* Processed in the USA, which regularly imports batches of 1.5 tonnes from Mexico, a few kilogrammes of *G. coulteri* per year are contained in US re-exports of the aforementioned sets to Germany (BARSCH *et al.* 2002).

The annual demand of *Guaiacum coulteri* in Germany is therefore estimated at between 50 and 90 tons in total (BARSCH *et al.* 2002).

3.3 Illegal trade

As *Guaiacum coulteri* is under special legal protection in Mexico (see 4.1.1), an approval by a competent government authority to harvest, use, possess or export this species is required (SEDESOL, 1994). One can assume that some of the traded *Guaiacum*-shippings are not authorised and thus illegal (MARYLAND-REPORT 2000). The amount of illegal trade is very difficult to determine. Despite insufficient identification of *Guaiacum* species exported from Mexico, most exports from Mexico to the USA are likely to be *G. coulteri* or *G. sanctum* (CITES COP 8, 1992).

International trade data are usually only listed as 'lignum-vitae' without disclosing the exact species traded (CITES COP 8, 1992; BENÍTEZ DÍAZ, *in litt.*, June 2002). The port of export may often be the only reasonable indication as to which species is traded based on the proximity of the port to the harvest location of the exported consignment (BENÍTEZ DÍAZ, *in litt.*, June 2002). The likelihood of *G. sanctum* or *G. coulteri* traded under their scientific names is low, due in part to a lack of knowledge among traders of these species and because of an established market for *G. officinale* (CITES COP 8, 1992).

Significant demand for *Guaiacum* in Germany and comparatively few imports of *Guaiacum* into Germany during the past several years suggest a discrepancy between reported and actual imports: only one import of *G. officinale* (in 1999: one piece of 1.3 meters) and *G. sanctum* (in 1994: 19.74 kilogrammes) have been recorded. Several explanations or a combination of these may account for the discrepancy between few import data and the actual annual demand of 50-90 tons of *Guaiacum* in Germany (BARSCH *et al.* 2002):

- Stock material of *Guaiacum sanctum* and *G. officinale* is used.
- The demand is primarily satisfied by imports of unreported *G. coulteri*.
- Erroneous false declaration of traded *Guaiacum sanctum* and *G. officinale* as *G. coulteri*, misidentified due to similarity of the different *Guaiacum* species.
- Illegal, undocumented imports of the CITES-listed species *G. officinale* and / or *G. sanctum.*

In 2000, Canada imported 1,450 kilogrammes of *G. coulteri*. Reports, however, indicate that the respective shipment had been exported as *G. sanctum* from Mexico (GROW & SCHWARTZMAN 2001). Apparently, trade data may reflect a number of different *Guaiacum* species, which undermines

efforts to effectively monitor and regulate the trade in CITES-listed species *G. officinale* and *G. sanctum*.

3.4 Actual or potential trade impacts

Populations of both *G. officinale* and *G. sanctum* have heavily declined due to over-exploitation and are threatened by or close to extinction throughout much of their natural range in the Caribbean. Therefore, the current trade of *Guaiacum* concentrates on the Mexican stock of *G. sanctum* (SCHIPPMANN 2001; GROW & SCHWARTZMAN 2001). *G. coulteri* is officially only traded in small amounts (GROW & SCHWARTZMAN 2001). One can expect, however, that as a consequence of the reduced availability of *G. sanctum* (IUCN Red List category EN C2a, according to WCMC 2000), future *Guaiacum* trade may lead to a potentially increased trade in *G. coulteri*. Both species look very similar in the wild and cannot be readily and clearly distinguished by non-experts, suggesting that *G. coulteri* or *G. sanctum* may be subject to accidental harvest by appearing as the other to harvesters (MARYLAND-REPORT 2000). Timber and wood of both species also look very similar.

3.5 Artificial propagation for commercial purposes (outside country of origin)

G. sanctum is cultivated in the United States of America. There is no information available as to whether *G. coulteri* is also cultivated for commercial purposes elsewhere.

4. Conservation and Management

4.1 Legal status

4.1.1 National

G. coulteri and *G. sanctum* are protected under Mexican law. They are listed as 'Pr' (subject to special protection) in the NOM-059-ECOL-1994 (SEDESOL 1994). An approval by a competent government authority is required prior to the harvest, use, possession or export of this species (SEDESOL, 1994).

4.1.2 International

International legal trade regulations and restrictions apply to the CITES-listed species *G. officinale* and *G. sanctum* but not to other *Guaiacum* species.

G. sanctum (timber only) has first been listed in CITES, Appendix II in 1975. In 1985, an annotation (#1) was added to the listing of *G. sanctum.* In 2000, the species was proposed to be transferred from Appendix II to Appendix I in 2000 (CITES COP 11, 2000). This proposal was withdrawn.

G. officinale has been listed in CITES, Appendix II (also with annotation #1), in 1992.

4.2 Species management

In some parts of its native distribution, *G. coulteri* occurs in protected areas. This is the case for the Cumbres de Cuixmala Reserve in Jalisco, which was first protected by the Mexican government in 1987 and subsequently established as the Chamela-Cuixmala Biosphere Reserve in 1993 (CPD: MIDDLE AMERICA, no date). *G. coulteri* is also protected in the Lagunas de Chacahua Parque Nacional (SEMARNAT, no date) and in the Huatulco Parque Nacional in Oaxaca (INSTITUTO NACIONAL DE ECOLOGÍA, no date), among other national parks.

G. coulteri is reportedly cultivated in a nursery in Sonora with 5,000 seedlings being raised (MARYLAND-REPORT 2000).

4.3 Control measures

According to most research, all traded commodities of *Guaiacum* species are difficult to distinguish from each other (MARYLAND-REPORT 2000). In the form of wood, *G. coulteri* and *G. sanctum* are particularly similar in appearance (MARYLAND-REPORT 2000; GROW & SCHWARTZMAN 2001; RICHTER 2001) considers *Guaiacum* among those timber species which can - by means of wood anatomy (based on structural and physical parameters) - only be differentiated to the genus level. Only new chemical or molecular biology methods may allow an identification on the species level.

Misidentification of timber has therefore in the past led to inaccurate reporting of species in trade. Some of these cases were detected by the customs offices (see 3.4). The number of undetected cases is difficult to estimate.

For these reasons, *G. sanctum* cannot be adequately protected as long as the trade of *G. coulteri* and potentially other *Guaiacum* species is not equally controlled.

4.3.1 International trade

Since 2001, the Mexican CITES Authorities have significantly reduced exports of *G. samnctum* from Mexico (BENÍTEZ DÍAZ, *in litt.*, June 2002). At the 12th meeting of the Plants Committee (Leiden, 13-17 May 2002), the Mexican delegation announced that an export quota for this species will be established in due course.

Control of international trade is difficult to enforce, due to the reasons mentioned in 3.3 and 3.4. In order to identify the of origin of *Guaiacum* timber and resin in trade or to distinguish between naturally or plantation-grown trees, tools like chemical or molecular-biological "finger-printing" would have to be developed (RICHTER 2001).

4.3.2 Domestic measures

The trade of both *G. coulteri* and *G. sanctum* is controlled by the Mexican law NOM-059-ECOL-1994 (SEDESOL 1994). They are listed as 'subject to special protection' (Pr). NOM-059-ECOL-1994 defines species in this category as 'species and subspecies of wood-land, terrestrial, and aquatic flora and fauna in danger of extinction, vulnerable species, rare species and species under special protection'. The law specifies that these species, parts or products from the listed species may be used or collected for scientific purposes and for purposes of obtaining mother plants or seeds for cultivation but not for commercial purposes. Prior government approval is required to harvest specimens for commercial use or to modify the habitat where listed species occur (SEDESOL 1994).

5. Information on Similar Species

Two species of the Zygophyllaceae family, *Bulnesia sarmientoi* Lorentz ex Griseb. and *Bulnesia arborea* (Jacq.) Engl., are also used for oil extraction and share the common names lignum-vitae and guaiac with the *Guaiacum* species (MERELES, pers. comm. 2002; MABBERLEY 1997; BENÍTEZ DÍAZ, *in litt.*, June 2002). They are, however, not recorded in the database of internationally traded medicinal plant species held by the German Federal Agency for Nature Conservation (LANGE & SCHIPPMANN 1997). International trade in this species and their products is therefore unlikely.

6. Other Comments

The proposed listing of the remaining taxa of *Guaiacum* is supported by the Mexican authorities (BENÍTEZ DÍAZ, *in litt.*, June 2002; CLEMENTE, *in. litt.*, June 2002). The technical information provided was incorporated in the supporting statement.

7. Additional Remarks

The proposal to list *G. officinale* in CITES Appendix II (CITES COP 8, 1992) stated that listing *G. coulteri* in CITES Appendix II would be justified under the look-alike provision [CITES II, 2(b)].

8. References

BARSCH, F., HONNEF, S. & MELISCH, R. (2002): Handel mit *Guaiacum coulteri* in Deutschland.- TRAFFIC-Europe Germany im Auftrag des Bundesamtes für Naturschutz, 5 pp. and annex.

CITES COP 8 (1992): Proposal for amendment of CITES appendices: Include in Appendix II *Guaiacum officinale*.- Proponent: The United States of America.

CITES COP 11 (2000): Proposal for amendment of CITES appendices (Prop. 11.62): Transfer of *Guaiacum sanctum* from Appendix II to Appendix I.- Proponent: The United States of America.

CPD: MIDDLE AMERICA (no date): Pacific Lowlands, Jalisco: Chamela Biological Station and Cumbres de Cuixmala Reserve.- www.nmnh.si.edu/botany/projects/ cpd/ma/ma7.htm (viewed 5.3..2002).

DESERT TROPICALS (no date): Guayacan (*Guaiacum coulteri*).- www.desert-tropicals/Zygophyllaceae. (viewed 5.3..2002)

GROW, S. & SCHWARTZMAN, E. (2001): The status of *Guaiacum* species in trade.- Medicinal Plant Conservation, **7**: 19-21, IUCN Medicinal Plant Specialist Group.

HAUDE, M. E. (1998) : Identification of colorants on maps from the early colonial period of New Spain (Mexico).- Journal of the American Institute for Conservation, **37 (3)**: 240-270.

HEALTHLINK (no date): *Guaiacum*. www.healthlink.com.au/nat_lib/htm-data. (viewed 5.3..2002)

HONCOOP, J. (1997): Notes on the Migratory Sulphur, *Kricogonia lyside* .- www.sasionline.org/sulf/kric.html (viewed 5.3..2002).

INSTITUTO NACIONAL DE ECOLOGÍA (no date): Huatulco, Parque Nacional (PN).- www.ine.gob.mx/ucanp/data/consultaFicha. (viewed 5.3..2002)

INSTITUTO NACIONAL DE ESTADISTICA, GEOGRAFICA E INFORMATICA (no date): Aspectos geográficos de Sinaloa. Agricultura y vegatación. www.sin.inegi.gob.mx/territorio/espanol/ agr_veget.html. (viewed 5.3..2002)

MARYLAND-REPORT (THE 2000 PROBLEM-SOLVING TEAM) (2000): *Guaiacum sanctum*: Population status and trade in Mexico with CITES recommendations.- Graduate Program in Sustainable Development and Conservation Biology, University of Maryland, College Park. Prepared for the Office of Scientific Authority, United States Fish and Wildlife Service; 51 pp.

MIELKE, J (1993): Native Plants for Southwestern Landscapes.- University of Texas Press, Austin.

MIRANDA, H. & ALCALÁ, C. (1989): Inventario florístico del rancho demonstrativo 'La Granada'.- Investigación Pecuaria en el Estado de Sonora. CLAVE P89018. www.patrocipes.uson.mx /patrocipes/invpec/pastizales/P89018.htm (viewed 5.3.2002)

PORTER, D. M (1972): The genera of the Zygophyllaceae in the Southeastern United States.- Journal of the Arnold Arboretum, 53: 531-532.

RESEARCH & EXTENSION CENTER VIRTUAL HERBARIUM (2000) : Guayacan.- http://uvalde.tamu.edu/herbarium/guan.htm. (viewed 5.3..2002)

RICHTER, H. G. (2001): Wood anatomy – possibilities and limitations.- Symposium zu Methoden der Holzidentifizierung, Hamburg.

SCHIPPMANN, U. (2001): Medicinal plants significant trade study. CITES project S-109. Plants Committee Document PC9 9.1.3 (rev.).- 97 pp., Bundesamt für Naturschutz, Bonn (BfN-Skripten 39).

SEMARNAT (SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES) (no date): Escalera Náutica. Mar de Cortés.- www.semarnat.gob.mx/regiones/lagunas-chacahuas/flora (5.3.2002).

SEDESOL (SECRETARÍA DE DESARROLLO SOCIAL) (1994): Norma Oficial Mexicana NOM-059-ECOL-1994, que determina las especies y subespecies de flora y fauna silvestres terrestres y acuáticas en peligro de extincción, amenazadas, raras y las sujetas a protección especial, y que establece especificaciones para su protección.- Diario Oficial de la Federación 16/05/94; 2-60.

WCMC (2000): Contribution to an evaluation of tree species using the new CITES listing criteria.- UNEP-WCMC, 440 pp.

WIGGINS I. L. (1964): Flora of the Sonoran Desert: Zygophyllaceae. *Guaiacum*.- In: F. Shreve & I. L. Wiggins: Vegetation and Flora of the Sonoran Desert, **1**: 745-746. Stanford University Press, Stanford.

WOODEX (no date): Woodex Meco Systems wood bearings & mechanical shaft seals.- Wooden Bearings? Come On!- www.woodex-meco.com/woodhome.html. (viewed 5.3..2002).

Personal communications and correspondence

BENÍTEZ DÍAZ, H, Conabio, Mexico D.F., *in litt.* to German CITES SA, 3.6.2002

BMVEL, Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft, *in litt.* to German CITES SA, 28.5.2002

CLEMENTE, F., Secretario de Medio Ambiente y Recursos Naturales, Mexico D.F., *in. litt.* to German Minsiry of Environment, 21.5.2002

MERELES, M. F., Universidad de Asuncion, pers. comm. 13.5.2002

REUTER, A., Representante para Mexico de TRAFFIC Norteamericana, Mexico City, *in litt.* to TRAFFIC Europe-Germany, February 2002

ROBBINS, C., TRAFFIC North America, Portland, pers. comm.

SCHLEGEL, S., Institut für Altamerikanistik und Ethnologie, Universität Bonn, pers. comm.

TODD, M., Department of Psychology, Arizona State University, *in litt*., February 1999.