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

Twenty-fifth meeting of the Plants Committee
Geneva (Switzerland), 17 and 20-23 July 2020

Species specific matters

BOSWELLIA TREES (*BOSWELLIA* SPP.)

1. This document has been submitted by the Secretariat.

Background

2. At its 18th meeting (CoP18, Geneva, 2019), the Conference of the Parties adopted Decisions 18.205 to 18.208 on *Boswellia trees (*Boswellia *spp.)*, as follows:

18.205 Directed to the Secretariat

The Secretariat shall issue a Notification to the Parties and, as appropriate, liaise with relevant stakeholders of Boswellia trade, requesting the following information:

a) biological data on Boswellia species, including population size, distribution, status and population trends, identification information, and its role in the ecosystem in which it occurs;

b) available information about harvest and exploitation levels, trade names, stakeholders close to the harvest of the species and supply chain characteristics for domestic consumption and international trade;

c) information on threats to these species, especially as it pertains to the underlying causes of poor regeneration capability and the impact of harvest on these species;

d) information on any initiatives to artificially propagate these species or produce plantations of them;

e) existing regulations and ownership structures pertaining to the species, and their habitat, drivers of habitat trends and management measures in place or under development, including sustainable harvest practices; and

f) suggestions for meetings or other venues that might provide opportunities to collaborate or share information regarding harvest and management of these species.

18.206 Directed to the Secretariat

The Secretariat shall compile and submit for consideration of the Plants Committee information received as per Decision 18.205.

18.207 Directed to the Plants Committee

The Plants Committee shall review the information received and other relevant information available to it regarding the status, management, and trade in Boswellia *species, highlighting key gaps in knowledge and making recommendations to inform further efforts to address the*

sustainable use and conservation of these species, including whether any of the species meet the criteria for listing under CITES.

18.208 Directed to the Parties

Range States and Parties involved in management, propagation, or trade of Boswellia *species are encouraged to provide information to the Secretariat, as requested in Decision 18.205.*

Implementation of Decision 18.205

3. On 10 February 2020, the Secretariat published Notification 2020/010 and its Annex on *Questionnaire on Boswellia trees (*Boswellia *spp.)*. The questionnaire was developed in consultation with the Plants Committee, as well as the United States of America and Sri Lanka, as authors of document CoP18 Doc. 66 on *Trade in* Boswellia *spp. (Burseraceae)*. It was designed to cover all aspects outlined in Decision 18.205.

4. The Secretariat received responses to the Notification from 11 Parties: Cambodia, Cameroon, Eritrea, Ethiopia, Germany, Malta, Monaco, New Zealand, Slovakia, Switzerland and the United States of America and one Non-Party: South Sudan. The following stakeholders also submitted responses: Arbor Oils of Africa (Kenya); Centre for Frankincense Environmental and Social Studies (CFESS, Somalia); Chemiloids Life Sciences Pvt Ltd. (India); Global Frankincense Alliance (GFA); INDFRAG Biosciences Pvt Ltd. (India); Neo Botanika (Somalia); TRAFFIC; and four independent experts reporting on *Boswellia* in India.

5. Some of the responses enumerated in paragraph 4 above contain extensive background research. Germany assessed whether four *Boswellia* species (*B. frereana, B. papyphera, B sacra, B. serrata*) are meeting the CITES listing criteria in Resolution Conf. 9.24 (Rev. CoP17) on *Criteria for amendment of Appendices I and II*; provided an overview of German gum and resin markets (ProFound, Duerbeck 2015); and produced species data factsheets on *B. frereana, B. neglecta, B. rivae, B. papyphera,* and *B. sacra* that collate scientific references compiled in the MAPROW database[1] (Schippmann, 2018 a-e). Cameroon submitted a comprehensive review of *Boswellia* resources and their utilization, national non-timber forest product (NTFP) regulations, and a strategic research and management plan to enable the sustainable use of *Boswellia* spp. The United States of America submitted trade data from the zauba.com database, and supplementary information from the American Herbal Products Association (AHPA) pertaining to the use of *Boswellia* in the U.S. dietary supplements industry. Arbor Oils of Africa (Kenya) submitted a sustainable harvesting protocol, a gum and resin value chain desk study, and a field appraisal of the state of *Boswellia* species and frankincense commercialization in Kenya. The Centre for Frankincense Environmental and Social Studies (Somalia) submitted a report on historical and present regulations, socio-economic aspects, and management approaches of *Boswellia* populations in the Somaliland region of Somalia. The Secretariat also received some additional scientific publications and other supporting materials.

6. As per Decision 18.205 and in order to ensure a comprehensive compilation of information, the Secretariat also liaised with the following relevant stakeholders: the Permanent Observer Mission of the Holy See to the United Nations Office and other international organizations in Geneva; the Biotrade programme of the United Nations Conference on Trade and Development (UNCTAD); the Medicinal Plants Specialist Group of the International Union for Conservation of Nature (IUCN); the IUCN Global Tree Specialist Group and the Union for Ethical BioTrade (UEBT).

7. The IUCN Global Trees Specialist Group will prioritize updated Red List assessments of all *Boswellia* species in its Global Trees Assessment Initiative. Updated Red List assessments for the genus are expected to become available in 2021 or 2022. A review of currently available Red List assessments is available in document CoP18 Doc. 66, and in the response from the United States of America.

Implementation of Decision 18.206

8. The information on *Boswellia* that was submitted to the Secretariat is substantial (several hundred pages). As directed in Decision 18.206, the Secretariat has compiled it, and for ease of review, summarized and structured it along the six thematic areas indicated in Decision 18.205. The Secretariat's compilation is presented in Annexes to the document as follows:

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[1] *The MAPROW (Medicinal and Aromatic Plant Resources of the World) database was created by the former co-chair of the IUCN medicinal plants specialist group Uwe Schippmann. It compiles available scientific information on ca. 28,000 medicinal and aromatic plant species.*

a) Annex 1: biological data on Boswellia species, including population size, distribution, status and population trends, identification information, and its role in the ecosystem in which it occurs;

b) Annex 2: available information about harvest and exploitation levels, trade names, stakeholders close to the harvest of the species and supply chain characteristics for domestic consumption and international trade;

c) Annex 3: information on threats to these species, especially as it pertains to the underlying causes of poor regeneration capability and the impact of harvest on these species;

d) Annex 4: information on any initiatives to artificially propagate these species or produce plantations of them;

e) Annex 5: existing regulations and ownership structures pertaining to the species and their habitat, drivers of habitat trends and management measures in place or under development, including sustainable harvest practices; and

f) Annex 6: additional observations.

9. All original submissions, including additional materials, will be made available to the present meeting in an information document, in the language and format in which they were submitted.

Summary and preliminary conclusions

10. From the six thematic areas in Decision 18.205, the Secretariat received substantial information on paragraphs a), c), d) and e), even though some gaps remain for several range States, and for species less commonly found in international trade. Regarding information about harvest and exploitation levels, trade names, stakeholders close to the harvest of the species and supply chain characteristics for domestic consumption and international trade [paragraph b)], the Secretariat received information on local harvest in certain range States, but information is largely lacking on domestic consumption and international trade in processed products. Regarding suggestions for meetings or other venues that might provide opportunities to collaborate or share information regarding harvest and management of these species [paragraph f)], the Secretariat received suggestions of relevant events in which *Boswellia* stakeholders would be present. However, many of these were cancelled or postponed due to the current coronavirus pandemic. While data is lacking or scarce in some areas, several tentative conclusions can be drawn from the information submitted to the Secretariat, in particular for those species and range States that are most prominent in trade.

Biological data on Boswellia *species, including population size, distribution, status and population trends, identification information, and its role in the ecosystem in which it occurs*

11. *Boswellia* habitats are widely reported to be marginal soils of limited fertility, often hot, exposed, rocky or steep, in otherwise unproductive areas prone to desertification. There seems to be a gradient of tolerated humidity, from semi-deserts (e.g. in Oman), to dry deciduous woodlands (described for *B. serrata* in India), to high rainfall savannas (reported for South Sudan), and moist lowland agroecological zones (reported by Eritrea). Boswellia is recommended for desertification control, and described as reducing soil degradation, enriching soil fertility, sustaining microclimates, providing plant cover, as habitat for owls and other animal species, as providing animal fodder, and as source of nectar for bees. The species are vital in holding the soil with their root systems and protecting it from erosion, especially where grass and herbs are grazed down or dried out in the drought periods.

12. The populations of some *Boswellia* species, in particular *B. papyphera*, have been declining and deteriorating for several decades. Causes are, *inter alia*: regeneration problems due to overharvesting; overgrazing; and perhaps an intrinsic vulnerability of *Boswellia* species. Formal management, monitoring or regulation of harvest of and trade in *B. papyphera* is virtually absent. Informal or traditional harvest management schemes seem to suffer from lack of capacity, poverty, and societal conflicts (in particular between ancestral local communities and external harvesters or nomads). The three main exporting range States of *B. papyphera*, Eritrea, Ethiopia and South Sudan, all confirm these observations.

13. Populations of other species, in particular *B. serrata* and *B. ovalifoliolata* in India, seem more resilient, less degraded, and better managed.

14. While classified as Critically Endangered/Near Extinct in the IUCN Red List, the available information remains unclear whether, and in what volumes, *B. serrata* in Sri Lanka is harvested and internationally traded.

15. The conservation status is less clear for species native to East Africa and the Horn of Africa, in particular *B. sacra, B. frereana, B. neglecta*, and *B. rivae*. Available information suggests that it may depend on the range State or subnational characteristics. For Ethiopia, there is nothing to suggest that their status would substantially differ from *B. papyphera*. Some populations in Somalia may be affected by similar threats, but in particular in the Somaliland region, these threats may be less severe than in other North-East African countries. Local sources from the Somaliland region state that populations of *B. sacra, B. frereana* and *B. rivae* are largely healthy, and point out that no scientific field research has been conducted in the country since the 1980s. Oman did not submit information. Other sources suggest that its populations of *B. sacra* and *B. frereana* may be threatened, but also that substantial species conservation efforts exist. Information is very scarce for Kenya, but *B. neglecta* populations seem relatively little traded and may be in a relatively good shape.

16. The identification at species-level of the major raw *Boswellia* products in trade (i.e. gums, resins, extracts) is reportedly possible by experienced traders, based on colour and taste. Some studies suggest that at least some of the most heavily traded species can also be identified through chemical tests. However, it remains unclear if species-identification at the global level by non-experts would be feasible, and whether the available tests are sufficiently reliable to identify lesser-known, highly processed, or deliberately adulterated products.

Available information about harvest and exploitation levels, trade names, stakeholders close to the harvest of the species and supply chain characteristics for domestic consumption and international trade

17. *Boswellia* seem mostly harvested and collected by individual collectors or communities. However, Ethiopia reports that commercial entities were the main collecting institutions.

18. Based on the available information, trade in *Boswellia* products is a large and highly complex global value chain that spans several industrial sectors (medicine, cosmetics, religious and cultural sectors, among others). Most international trade seems to derive from six *Boswellia* species (*B. frereana* known only from Somalia; *B. sacra* from Oman, Somalia and Yemen*; B. papyrifera* from Ethiopia and Sudan; *B. rivae* from Ethiopia; *B. neglecta* from Ethiopia and Kenya; and *B. serrata* from India). Major exporting range States include India, Ethiopia and Somalia. Several other range States in North Africa, the Horn of Africa, and the Arabian Peninsula are exporting lesser quantities.

19. The total annual resin harvest of, and trade in *Boswellia* products is unknown for virtually every range State. However, it is known to be substantial. Estimations of the combined annual exports from India, the Somaliland region of Somalia, and Ethiopia are totalling up to 4,000 tons, and institutions like the Orthodox Church of Ethiopia are reported to domestically consume 2,000 tons a year. However, the total production potential may be very high, although largely unclear. One source reports an annual production potential of 57,000 tons in Ethiopia alone, but it remains unclear on what assumptions this estimate is based.

20. Little information is available about resin processing and the international trade in products such as incense sticks, and cosmetic or medicinal products. Major importing countries for *Boswellia* products from Ethiopia are China, Egypt, Germany, Guatemala, and the United Arab Emirates. Dubai, France, Saudi Arabia and Yemen are major importers of frankincense from Eritrea. Main importers of Sudanese frankincense include China, France, Germany, Italy, Saudi Arabia, and the United Arab Emirates. China seems to be the largest market of *Boswellia* for use in traditional medicines. India seems to largely export to Trinidad and Tobago, North and Central America, and European countries.

21. It remains unclear whether the extracts and resins of different *Boswellia* species in global value chains are considered interchangeable. If so, observed declines in the global supply of products derived from some of the major *Boswellia* species in trade, and the potential trade impacts of species-specific CITES listings may lead to shifts in supply, as has been observed for other species groups such as tropical timbers. If any future CITES listings were restricted to specific *Boswellia* species, such shifts could potentially lead to export from range States that are currently less involved in the trade, or to trade in *Boswellia* species not included in the listing that are thus more exposed to unregulated trade.

Information on threats to these species, especially as it pertains to the underlying causes of poor regeneration capability and the impact of harvest on these species

22. Widely reported threats to the genus are habitat loss, grazing, overexploitation of resin and wood, forest fires, insect damage, and lack of regeneration. However, no single threat seems to affect the species equally, and there may be important distinctions between species, countries, and regions. In particular, it seems unclear to which degree regeneration problems and lack of younger age classes of *Boswellia* populations is caused by lack of biological vulnerability of the genus, reduced seed production or reduced seed fertility due to overtapping the trees, or due to sapling destruction through grazing or fires. It seems unclear if low regeneration is the result of harvest. Rather, low regeneration may be a function of the harsh environmental conditions in which these species are found, combined with the impacts of harvest. There are also widespread reports that vegetative reproduction is often easy, and that at least some *Boswellia* species and populations in India, Kenya, and the Somaliland region of Somalia are large, bountiful and well-regenerating.

Information on any initiatives to artificially propagate these species or produce plantations of them

23. *Boswellia* seems to be largely harvested from the wild. However, initiatives to foster enrichment planting or propagate artificially *Boswellia* species exist in several range States, some of them at a relatively large scale. It remains unclear whether propagation through sexual reproduction is successful. Vegetative reproduction on the other hand is widely reported to be easy and straightforward. Its success seems to depend mainly on the protection of saplings from drought, fire, and grazing.

Existing regulations and ownership structures pertaining to the species, and their habitat, drivers of habitat trends and management measures in place or under development, including sustainable harvest practices

24. Ownership structures seem to vary between range States, and ownership over *Boswellia* resources and harvest rights seem to be subject of social conflicts in range States such as in Sudan and Eritrea. Some *Boswellia* species or populations seem protected at local or national level in some range States, in particular in India, Oman and the Somaliland region of Somalia. Several other range States report that little protection or management activities are in place.

25. Several sources describe in considerable detail sustainable resin harvesting practices to avoid tree mortality and degeneration of *Boswellia* populations. It is not clear from the available information whether and to what extent sustainable harvesting methods might also differ between *Boswellia* species, climates, or geographic areas.

Suggestions for meetings or other venues that might provide opportunities to collaborate or share information regarding harvest and management of these species

26. Some suggestions were provided for relevant events in which *Boswellia* stakeholders would be present to collaborate or share information. However, most of these events were cancelled or postponed due to the current coronavirus pandemic.

Recommendations

27. The Plants Committee is invited to note the fulfillment of Decisions 18.205-206 through the report in the present document and to establish an intersessional working group on Boswellia trees (*Boswellia* spp.) to:

    a) review the compilation of information in document PC25 Doc. 25 and its Annexes, and other relevant information regarding the status, management, and trade in *Boswellia* species available to it or provided through information documents;

    b) highlight key gaps in knowledge and propose recommendations for further efforts to address the sustainable use and conservation of these species, including whether any of the species meet the criteria for listing under CITES; and

    c) submit the outcomes of its work to the Plants Committee for consideration at its 26th meeting.

Biological data on Boswellia species, including population size, distribution, status and population trends, identification information, and its role in the ecosystem in which it occurs
[Decision 18.205, paragraph a)][2]

1. Document CoP18 Doc. 66 lists 18 species of the genus *Boswellia* (see Annex 1 to that document) and provides details on its economic importance and its role in the ecosystem (paragraph 8). *Boswellia* habitats are widely reported to be marginal soils of limited fertility, often hot, exposed, rocky or steep, in otherwise unproductive areas prone to desertification. There seems to be a gradient of tolerated humidity, from semi-deserts (e.g. in Oman), to dry deciduous woodlands (described for *B. serrata* in India), to high rainfall savannas (reported for South Sudan), and moist lowland agroecological zones (reported by Eritrea). *Boswellia* is recommended for desertification control, and described as reducing soil degradation, enriching soil fertility, sustaining microclimates, providing plant cover, as habitat for owls and other animal species, as providing animal fodder, and as source of nectar for bees. The species are vital in holding the soil with their root systems and protecting it from erosion, especially where grass and herbs are grazed down or dried out in the drought periods.

2. All provided species-specific information relates to one of two groups of *Boswellia* species: *B. dalzielii, B. frereana, B. microphylla, B. neglecta, B. odorata, B. ogadensis, B. papyphera, B. pirottae, B. rivae*, and *B. sacra* native to the African Sahel, North-Eastern Africa and / or the Arab Peninsula in one group; and *B. serrata* native to India and Sri Lanka and *B. ovalifoliata* endemic to Andhra Pradesh in India in another group.

3. Cameroon reports to be a range State to *B. dalzielii* and *B. papyphera* (Betti 2020). In addition to some local and regional studies and inventories, quantitative evidence of their population density is available from a nation-wide forest inventory undertaken in 2004 by the Food and Agriculture Organization of the United Nations (FAO). Uniform sampling sites (2 hectares each) were designated on a rectangular grid throughout the entire country, 46 of which fell into Adamaoua, North and Far North regions recognized as *Boswellia* habitat. Average *Boswellia* stem density per hectare in these habitats was determined to be 1.1. The vast majority of individuals in the sampling sites (101 out of 102) were identified as *B. odorata*, one as *B. papyphera*. However, Cameroon regards the *B. odorata* specimen as possible misidentifications, and suggests these might be either *B. dalzielii* or *B. papyphera* (Betti 2020).

4. Comparable information was not provided for any other country. In addition to the information contained in the section on utilization and trade and Annex 1 to document CoP18 Doc. 66, the following information was provided (Table 1).

Table 1: Available information on the population status of *Boswellia* species.

Species	Comments
B. frereana	Native to the Horn of Africa, in particular Somalia (Bongers 2019). An analysis by Germany (BfN 2015a) assesses the species as locally abundant, present in several habitats, but over a small geographic area. It reports an estimate of a Dubai-based company to have 100,000 *B. frereana* trees on their land alone. Reliable information on population trends for this species seems to be unavailable, but Brendler (2018) reports anecdotal evidence of declining populations. Unsustainable tapping methods are reported by Schippmann (2018d). Poor recruitment of young trees has been confirmed for habitats of *B. frereana* in "Somaliland" by one oral source. The "Somaliland"-based company Neo Botanika (2020) reports the species as of no concern, and its population trends and habitat trends to be stable. The Somaliland-based CFESS points to the lack of empirical field studies needed for long-term interdisciplinary research.

[2] *The majority of stakeholders whose contributions is summarized in Annexes 1 to 6 refer to "Somaliland" and "Puntland". The Secretariat notes that the sovereignty of "Somaliland" and "Puntland" is not internationally recognized.*

Species	Comments
B. microphylla	Reported in document CoP18 Doc. 66 as synonym of *B. neglecta*, and native to Ethiopia, Kenya, Somalia, the United Republic of Tanzania, and Uganda. Ethiopia (2020) reports population status and trends as unknown, but the habitat trend as stable. The species is reported in two districts in Kenya, with unknown population status, population trends and habitat trends (Oils of Africa 2020).
B. neglecta	Native to the Horn of Africa, from Somalia and Ethiopia to the Kenyan – Tanzanian border region (Bongers 2019). Ethiopia (2020) reports population status, and population and habitat trends as unknown. The Kenya-based company Oils of Africa (2020) reports it to be of no concern, and as widespread in East Africa, with unknown total population and habitat trends. It also reports the species to be locally dominant, with recorded population densities of 25 to 662 specimen per hectare and a total collection area of 895,250 hectares. In one single collection area with 50,000 hectares, the population estimate is 12 million specimens. Schippmann (2018a) reports it as locally common in Kenya, and unknown for rest of the range.
B. ogadensis	Native to Ethiopia (CoP18 Doc. 66). Ethiopia (2020) reports population status, and population and habitat trends as unknown.
B. papyphera	Has a disjunct distribution between North-East tropical Africa (Chad, Eritrea, Ethiopia, Sudan, Uganda) and West tropical Africa (Cameroon, Central African Republic, Nigeria) (Schippmann 2018b). Eritrea (2020) considers its population to be endangered and describes it as fragmented remnants separated by vast plains and riverine areas in two regions, while relatively large areas of intact *B. papyrifera* woodlands were found in at least one other region. Visits were undertaken to 64 villages throughout two administrative regions in which *B. papyhera* is known to occur. Among these, *B. papyphera* was found present in 21, had disappeared in 15 and was absent from 28 villages. In a third region, *B. papyrifera* was and is present in about one third of the villages. South Sudan (2020) reported its population status as unknown. Both countries reported population and habitat trends to be decreasing. Ethiopia (2020) reported population status, population trends and habitat trends as unknown. According to the BfN, the total population is unknown, but likely to still be large. It is assessed as locally abundant in several habitats and over a large geographic area. Yet, it is also reported as having declined in the past and likely continuing to decline at present (BfN 2015b). Declining regeneration and spatial shrinkage of *B. papyrifera* woodlands have been observed in much of the natural range: More than 76% of *Boswellia* trees in northern Ethiopia have a breast height diameter greater than 30 cm. As a result of declining populations in Eritrea, frankincense export dropped from 2,000 tons in 1974 to 400 tons in 1998 (Schippmann 2018b). Comparing the 1955 and 1996 national forest inventories of Sudan reveals that *B. papyphera* distribution in its habitat reduced from 25% to 15.7% (BfN 2015b). Bongers (2019) sampled *B. papyphera* populations in 23 sites (two in Sudan, five in Eritrea, 16 in Ethiopia). They identified severe regeneration failures despite high germination rates and local abundance of seedlings, since seedlings did not transition to saplings (>1 cm stem diameter) in most populations. Based on population dynamic models and taking into account that *B. papyphera* currently supplies two thirds of the global frankincense production, they predict fast collapsing *B. papyphera* populations and halving of frankincense harvest in 20 years. If current practices continue, other studies predict a 90% decline in the size of both tapped and untapped *B. papyrifera* populations in Ethiopia within 50 years and a 50% decline in frankincense yield within 15 years. By 2040, the stem density of *B. papyrifera* populations in two districts of Ethiopia would be reduced to 3% and 11% of their current size (BfN 2015b).
B. pirottae	Native to Ethiopia (CoP18 Doc. 66). Ethiopia (2020) reports population status, and population and habitat trends as unknown.
B. rivae	Native to Ethiopia, Somalia and Kenya (CoP18 Doc. 66). Ethiopia (2020) reports population status and trends as unknown, but the habitat trend as stable. The Kenya-based company Oils of Africa (2020) reports population status, and population and habitat trends as unknown. Species-specific scientific literature for Somalia seems unavailable (Schippmann (2018e), but the “Somaliland”-based company Neo Botanika (2020) reports the species as of no concern, and its population trends and habitat trends to be stable.

Species	Comments
B. sacra	Native to the Horn of Africa, Yemen and Oman (Bongers 2019). The populations are assessed as locally abundant in a specific habitat over a large geographic area. Information on population trends seems contradictory and populations in remote or inaccessible areas of, such as cliffs, may be less affected. Schippmann (2018) reports large and dominant population sizes in some places, but severely deteriorating gum and resin producing vegetation in most producing countries. He suggests that perhaps one half of the *Boswellia* population in Somalia is to some degree damaged. Yet, the "Somaliland"-based company Neo Botanika (2020) reports the species as of no concern, and its population trends and habitat trends to be stable. It states that the resource base in "Somaliland" was massive, while areas of overtapping were limited and not posing a risk to the populations. Neo Botanika also points out that harvest in some populations is FairWild certified. The "Somaliland"-based CFESS (2020) points out that no research has been conducted in Somaliland since 1981 and suggests that some studies were based on dubious approaches and sources, and very little on-the-ground research. Other reports would extrapolate their findings in Ethiopia, Eritrea and Sudan to "Somaliland" without considering local specificities. Long-term interdisciplinary research was needed. In Oman, the tree is reported as so heavily browsed that it rarely flowers or sets seed (Schippmann 2018). BfN (2015c) reports that the Environment Society of Oman (ESO) estimated the number of "fully-grown" *B. sacra* trees at 400,000 to 500,000 trees in 2009. While not all trees were being tapped, in some areas the trees had almost completely vanished (BfN 2015c).
B. ovalifoliolata	Endemic to small areas of Andhra Pradesh in India. Responses from India describe the population as available (Suthari 2020), vulnerable (Venugopal 2020) or endangered (Chemiloids Life Sciences 2020, Hemadri 2020, Pullaiah 2020). The population trend was reported as stable (Chemiloids Life Sciences 2020, Pullaiah 2020, Venugopal 2020) or increasing (Suthari 2020). All responses agree that habitat trends were stable.
B. serrata	Native to India and Sri Lanka. It is critically endangered and possibly extinct in Sri Lanka, and listed as rare in the Indian Red Data Book, and in some Indian States considered as vulnerable (CoP18 Doc. 66, Brendler 2018). However, Venugopal (2020) reports the species to occur in 16 Indian States. Based on a recent survey in about 100 forest ranges in Madhya Pradesh, he reports population densities of 40-100 trees per hectare in most surveyed forests, with an estimated total population of 20 million trees in 23 forest divisions of Madhya Pradesh. He also informs that similar surveys in the 15 remaining Indian States are due. Brendler (2018) confirms that populations were still large. Unlike *B. papyrifera*, where quantitative studies showed that populations in African range States have been in decline for decades, there was no comparable quantitative evidence for *B. serrata*. The populations are unambiguously described as of no concern by six responses from India (Chemiloids Life Sciences 2020, INDFRAG 2020, Suthari 2020, Hemadri 2020, Pullaiah 2020, Venugopal 2020). The population trend was described as stable (Hemadri 2020, Pullaiah 2020, Suthari 2020) or increasing (Chemiloids Life Sciences 2020, INDFRAG 2020, Venugopal 2020). Five responses described habitat trends as stable, and one as increasing (Chemiloids Life Sciences 2020). Venugopal (2020) suggests that the predominant presence of vast stretches of *B. serrata* in many Indian states proves that it is abundant, uncountable in numbers, forms its own forests, and that there was no indication of it being endangered.

5. The identification of *Boswellia* products is described as potentially complex, not the least since there was taxonomic confusion over valid versus outdated names. No identification materials were provided to the Secretariat. Yet, AHPA (2020) reports that industry routinely uses various chromatographic analyses to identify products in trade, and DNA fingerprinting may also be available. Extracts that are standardized to specific levels of boswellic acid could be analyzed with available reference standards. Chemical analyses are also described as capable to distinguish the taxonomic origin of extracts, gums and resins from at least some species (BfN 2015b). BfN (2015d) refers to differences in composition and colour, and states that differentiation of the species and evidence for adulteration is possible through application of modern analytical tools and methods. A high-performance liquid chromatography based on three chemical indicators was able to identify any *B. serrata* extract. Similarly, frankincense from *Boswellia papyrifera*, *B. serrata* and *B. sacra* could be clearly distinguished from one another (BfN 2015b, c). Since *B. sacra* resin was bitter,

while *B. frereana* resin was not, these two species could be distinguished even without sophisticated chemical analyses (BfN 2015a). Oils of Africa (2020) states that the white tar of *B. neglecta* resin can be easily distinguished from the white resins of *B. sacra* and *B. papyifera*. The United States of America (2020) state that it was unclear to what degree chemical variation can distinguish *Boswellia* commodities to the species level. In addition, there was a potential for adulteration using other lesser-valued *Boswellia* species. The United States of America also report that products on the U.S. market legally require the species names be used on the product labels. They further suggest that for live plants, variation in leaf shape, number and size of leaflets can be used to distinguish among the East African species (*B. papyrifera, B. rivae, B. neglecta*, and *B. microphylla*), even though *Boswellia* trees are deciduous and leafless for much of the year. For more detailed information, the United States of America suggest three sources on chemical identification of *Boswellia* products (Brendler et al. 2018, Mathe et al. 2004, Meins et al. 2016), and two sources on morphological distinction of *Boswellia* specimens (Mugah et al. 1997, Thulin & Warfa 1987).

Available information about harvest and exploitation levels, trade names, stakeholders close to the harvest of the species and supply chain characteristics for domestic consumption and international trade
[Decision 18.205, paragraph b)]

1. The information received suggests that the vast majority of *Boswellia* use and trade is sourced from wild harvest. Stakeholders close to harvest and ownership structures vary by country.

   a) In India, many forests are owned by the government (Chemiloids Life Sciences 2020), but the recent Forest Act, Panchayats (Extension to Scheduled Areas) (PESA) Act and Biodiversity Act are ensuring the ownership of the resource by local communities (Venugopal 2020). The majority of *B. serrata* produce is harvested by tribal people in areas with special legislative arrangements classified as Scheduled Tribe territories (Brendler 2018). AHPA (2020) reports varied ownership and land tenure structure, that include government ownership, community ownership, or community-based land tenure, as well as private ownership in which trees are inherited or gifted to a bride and groom during marriage. Individual tribal collectors of *B. serrata* were inherited or been assigned by their communities a certain number of trees which they tap, harvest, and maintain. Under existing Indian government acts, only tribal populations living in the forest areas can tap and collect the gum and non-tribal outsiders do not have access to these activities. According to Venugopal (2020), *B. serrata* provides subsistence to over 20,000 tribal families in India. The company INDFRAG (2020) reports 2,000 to 3,000 collectors in Madhya Pradesh alone.

   b) The Kenyan constitution, Section 63(1), transfers land ownership to communities that are identified on the basis of ethnicity and that manage or use community forests and grazing lands, and whose boundaries are clearly defined, for example through riverbeds or mountains. In one district, communities have committees such as gum collection committees, that determine the management and use of the land and its resources (Oils of Africa 2020). Oils of Africa (2020) reports that it has 2,000 registered collectors and that their operations are organic certified and were also FairWild certified in 2013 and 2014. The gums and resins value chain desk study (Mercy Corps 2020) reports that, in general, harvest was conducted mostly by local people through traditional means, and often using equipment that was not up to technical standards to maintain quantity and quality of the product. On local and regional levels, there was a lack of access to market information; no collective bodies or associations exist; and there were no conflict resolution mechanisms in place. The system benefitted in particular traders.

   c) Ethiopia (2020) reports that several problems arise in relation to access to and management of the resource base. In some areas, communities own and manage the resource, whereas in others local communities' access to the resource is severely restricted. Only commercial producers with adequate capital are allowed to collect and sell gums and resins. These companies are given licenses to exploit an area for only one year. There are no forest management plans, nor is there any monitoring system to ensure that gum collecting and exporting companies are managing the forest responsibly. Schippmann (2018b) suggests that forestry is a long-term investment and requires secure ownership, clearly defined property rights, and a policy environment that grants local communities rights to access and benefit from dry forests. Yet, according to BfN (2015b), all land in Ethiopia belongs to the State. Balancing tapping and land rights with prices that are high enough to provide incentives to reduce the unsustainably high frequency and intensity of tapping were key issues. In one of the production areas in Ethiopia, no local villagers were involved in the collection or processing of frankincense. Instead, labour migrancy had occurred, with about 1,300 daily labourers coming from another region. Bongers (2019) states that state ownership in combination with lack of management and monitoring favours exploitative harvesting practices focused on short-term gain.

   d) In Somalia, the right to tap *B. frereana* and *sacra* trees belongs to families, while the right to tap *B. rivae* trees belongs to tribes (statement valid for "Somaliland", Neo Botanika 2020). CFESS (2020) describes *Boswellia* specimens in "Somaliland" as owned by families through a complex ownership system registered under a Gums and Resins Registration System. An estimated 5,000 kg of dry gum resin, 300 kg of essential oil and 2,400 kg of annual hydrosol harvest are FairWild certified, (Neo Botanika 2020, TRAFFIC 2020). Estimations of the number of persons involved in gums and resins production

and trade as a source of income vary between 10,000 in Somalia (BfN 2015a, c) and 70,000 to 100,000 in "Somaliland" alone (CFESS 2020). It is unclear to what degree these statements are valid for areas of Somalia other than "Somaliland". For example, BfN (2015a) reports Somali collectors were predominantly nomads. While, in the past, *B. frereana* trees were reportedly managed through a system of customary ownership that was well-known, tenure and tapping rights are now unclear and overexploitation is common. Due to political disturbances in the region, there had been major migrations both from and to Puntland from other parts of Somalia, disturbing traditional land tenure systems and collection protocols. *B. frereana* management was also affected by disputes over land and the uncertainty this causes for land and tree tenure. Some parts of the Sanaag region, one of the best areas for *B. frereana*, were claimed by both "Somaliland" and "Puntland".

e) In Eritrea (2020), family ownership, village ownership and state ownership have coexisted for many years, varying from place to place. A land law issued in 1994 has officially replaced the three traditional land tenure systems, but in practice, the situation has not changed.

f) South Sudan (2020) reports that the state owns land and resources in protected areas, while communities own resources in other areas. It also suggests that there are conflicts over local resources between communities and their local harvesters and outsiders, including migrant harvesters.

g) Surveys in Oman indicate decline in frankincense collection. In 2000, there were only 43 harvesters extracting frankincense inside the 45,000 km² Jabal Samhan Nature Reserve compared to about 2,000 before the 1970s (BfN 2015d).

2. Multiple local, common and trade names for the various species, products and quality levels in various languages are contained in the responses. Many names that commonly appear in international trade, or are used in scientific literature, or national and international legal and regulatory documents, are searchable in the web portal of the Medicinal Plant Names Service (MPNS). In addition, the United States of America (2020) report that there are legal labelling requirements pertaining to the use of trade names, and which differ depending on whether the material will be consumed. Under U.S. law, the use of common names for botanical ingredients in dietary supplements labeling must follow the guidance included in the publication *Herbs of Commerce*, and cosmetic labeling must follow the International Cosmetic Ingredient (INCI) Dictionary and Handbook. Accordingly, for dietary supplements, U.S. law dictates that the common name "frankincense" may only legally be used on labels of products containing *B. sacra* as a component ingredient. Similarly, for cosmetic ingredients, *B. carteri, B. frereana, B. sacra* and *B. serrata* are included in the naming guidelines for product labels under the International Nomenclature of Cosmetic Ingredients (INCI) system that is followed by the fragrance, cosmetic, and personal care products industries in many major markets, including the United States of America, Canada, Europe, China, Japan, and many other countries (see additional details and a table of IPNI names in section 4k of the response of the United States of America).

3. Estimations of the yield per harvested tree vary. Schippmann (2018 a, b, c) estimates yields of 0.07-1 kg per tree per year, but also refers to estimations as high as 3 kg per tree per year. Ethiopia (2020) reports 500g annual yield per tree (mainly *B. papyphera*). For "Somaliland", the CFESS (2020) estimates that one to four kg of resin is collected from a tree per season at an initial market value between USD 3-6 per kg. Oils of Africa reports annual yields of 80g per harvested *B. neglecta* individual (Oils of Africa 2020). Some additional information can be found in document CoP18 Doc. 66, paragraph 10. Schippmann (2018) and Bongers (2019) remark that local harvesters tend to be exploited and disadvantaged in comparison to middle-men and traders.

4. Schippmann (2018a, b, c) reports that there are six commonly traded *Boswellia* species: *B. frereana* known only from Somalia; *B. sacra* from Somalia, Yemen and Oman*; B. papyrifera* from Ethiopia and Sudan; *B. rivae* from Ethiopia; *B. neglecta* from Ethiopia and Kenya; and *B. serrata* from India. *B. ogadensis* is reported by Ethiopia (2020) as in trade. Trade in *B. ovalifoliolata*, which is endemic to India, is reported by the United States of America (2020). The India-based company Chemiloids Life Sciences (2020) states that here was gum tapping in this species prior to 2000-2002 in some tribal areas, but this was discontinued since the species was now under wildlife protection.

5. Trade data suffers from the lack of species or genus-specific customs codes in most countries. In the UN COMTRADE database, HS130190 '*Natural gum, resin, gum resin, balsam'* and HS330741 '*incense sticks*' are quoted (BfN 2015d). Brendler (2018) provides a table of national HS codes applicable for *Boswellia* products (Table 2). Most of the HS Codes shown in Table 1 are a result of rulings and are thus not species-specific, but rather are determinations made by customs authorities as to which 'other' code to place an article that is Not Elsewhere Specified or Included. The exceptions are codes specifically assigned to frankincense in the columns for Indian Trade Classification (ITC), Oman Customs (OC) and Saudi Customs

(SC). Brendler (2018) also remarks that, according to the zauba.com database, Indian companies use several different general or 'other' tariff codes for export shipments of essential oil of frankincense including HS 33011990, HS 33012590, HS 33012911, HS 33012950, HS 33012990, HS 33013099, HS 33019079, HS 33019090, HS 33029012, and HS 33029019. China's 8-digit tariff code HS13019020 includes *Boswellia spp.*, *Commiphora* spp., *Daemonorops spp.*, and *Dracaena* spp., among other gums and resins (BfN 2015d).

Table 1: Selection of national HS codes applicable for *Boswellia* products, according to Brendler (2018).

Traded form	BTI	CCCCS	CROSS	ITC	OC & SC
Dried resin	1301.90.0000	1301.9020	1301.90.9090	1301.9032	1301.90.7000
Essential oil	3301.29.41		3301.29.5050; 3301.29.5150		
Extract	1302.19.7000				
Food supplement	2106.90.9260				
Incense sticks	3307.41.0000		3307.41.0000		

BTI:Binding Tariff Information rulings of the European Commission Taxation and Customs Union.
CCCCS:Commodity Classification for China Customs Statistics (PRC).
CROSS:Customs Rulings Online Search System (U.S. Customs & Border Protection).
ITC:Indian Trade Classification.
OC:Oman Customs, Sultanate of Oman, Directorate General of Customs.
SC:Saudi Customs, Kingdom of Saudi Arabia Central Department of Statistics & Information.

6. Extensive trade information is available for *B. serrata* from India as the only known producing and exporting range State, which also has ample in-country processing capacity (Venugopal 2020, INDFRAG 2020). Venugopal (2020) reports the approximate annual harvest from India to be 1,000 tons from about 340,000 trees. Annual yield per tree was about 3 kg resin. Approximately equal shares of the harvest went to domestic market and were exported. Other sources do not fully reflect this amount but might possibly underreport, since they only analyse one particular HS code (see Annex 2, paragraph 5 above). Based on a survey of herb trading markets and international trade data, Brendler (2018) estimates domestic *B. serrata* gum trade to be greater than 100 tons per year, and annual frankincense exports at 100 tons (Table 3). In 2015-2017, the main destination for Indian frankincense was Trinidad and Tobago, followed by Germany. Upon cross-checking imports of Trinidad and Tobago (HS130190 in the UN COMTRADE database), it appears that Trinidad and Tobago is indeed a major importer of natural gums from India. However, the same database shows exports of only 7.5 tons for the years 2012–2015. Other major importers of Indian frankincense include Guatemala, Mexico, and the United States of America. The Secretariat did not receive information from Sri Lanka, but database excerpts provided by the United States of America show numerous entries of *B. serrata* extracts imported to the United States from Sri Lanka. It is unclear to what extent these are re-exported specimens harvested in India.

Table 2: Indian exports of frankincense (HS code 13019032) in 2015-2016 and 2016-2017 (Brendler 2018).

Country	Values in US$ Million			Quantity in Metric Tons (MT)		
	2015–2016	2016–2017	%Growth	2015–2016	2016–2017	%Growth
TRINIDAD	0.06	0.05	− 10.26	39.00	24.00	− 38.46
GERMANY	0.03	0.07	154.09	5.00	13.00	160.00
GUATEMALA		0.01		0.00	12.00	
MEXICO	0.02	0.02	37.58	27.00	6.00	− 77.78
USA	0.01	0.01	− 1.37	3.03	4.00	32.23
BELGIUM		0.02		0.00	3.50	
FRANCE	0.01	0.02	185.25	2.60	3.35	28.77
UK	0.00	0.00	92.31	1.00	2.00	100.00
LEBANON	0.01	0.00	− 76.47	4.00	2.00	− 50.00
CANADA		0.01		0.00	1.51	
MAURITIUS	0.02	0.00	− 83.04	7.60	1.10	− 85.53
SRI LANKA DSR	0.00	0.00	100.00	1.00	1.00	0.00
AUSTRALIA	0.01	0.01	36.70	0.56	0.56	0.72
SOUTH AFRICA		0.00		0.00	0.50	
ITALY	0.00	0.00	− 55.00	0.10	0.03	− 75.00
NEW ZEALAND	0.00	0.00	700.00	0.03	0.01	− 60.00
DJIBOUTI	0.01			0.85	0.00	
OMAN	0.01			1.83	0.00	
NETHERLAND	0.01			0.20	0.00	
ARGENTINA	0.01			2.00	0.00	
MOROCCO	0.02			7.00	0.00	
TOTAL	**0.22**	**0.24**		**102.8**	**74.56**	

7. Demand for *B. neglecta* products seems to be stable or perhaps even decreasing (Schippmann 2018a). The market for this species in northern Kenya is reported to be underdeveloped and fetching low prices. Annual purchase records for frankincense of this species in one Kenyan district are reported to vary between 75 kg (2013) and 21,817 kg (2018), while the potential harvest in a single collection area of 50,000 hectare would give an estimated potential yield of 288 tons and was estimated for one district to total 1,800 tons (Oils of Africa 2020).

8. The Horn of Africa is the world's prime production area for various *Boswellia* species, but data is relatively scattered and imprecise. Puntland, Somalia, is the world's largest production area of frankincense from *B. sacra*, followed by exports from "Somaliland". Further species harvested in Somalia include *B. frereana* and *B. rivae* (Neo Botanika 2020). CFESS (2020) reports that "Somaliland" exported about 1,000 tons of frankincense in 2017. Most exports go to China, the United Arab Emirates, Yemen, Saudi Arabia, Europe and the United States of America. However, no data existed on regional trade, which was a lot more significant than exports beyond the Horn of Africa region. The company Neo Botanika (2020) estimates annual harvest from *B. frereana* and *B. sacra* to a total of 500 tons (from 60,000 trees) each, and *B. rivae* harvests at 50 tons (6,000 trees) annually. Eight trading companies were active, with a single domestic processing facility, and local consumption was minimal in comparison of export. These local estimates seem higher than estimates in available literature. According to BfN (2015a, d), estimates of frankincense production in "Somaliland" vary between 200 to 700 tonnes per year with more than 99% destined for export. The estimated total production potential is reported between 1,000 and 2,500 tons of frankincense and other resins combined, of which an estimated 40% was *B. frereana* (BfN 2015a). Main high-quality exports are reported to go to the European Union and the United States of America, while the Middle East, Djibouti, Ethiopia, and Eritrea were importing lesser quality specimens. The last available data from Oman reports 66,707 tons of imports in 2008. Saudi Arabia reported a total of 871 tons of imports from Somalia in 2011-2013. Import statistics into Yemen for 2011-13 total 863,199 tons, but use HS130190, which may include products of other taxa. Of these imports, 44% are from Puntland, Somalia, 29% from "Somaliland", and the balance from other North African countries. It is not known what portion of China's imports of HS13019020 are comprised of *Boswellia* resin, but 2013 imports totalled 1,721 tons, mainly from Ethiopia and Sudan, and in lesser volumes from Kenya, Somalia, Nepal and India (BfN 2015d). Some additional data is contained in document CoP18 Doc. 66.

9. Extensive information is available on *B. papyphera*, which is mainly produced and exported in Eritrea, Ethiopia, South Sudan and possibly Sudan (BfN 2015b). Other countries, such as Cameroon (Betti 2020), seem to not be active in frankincense production and to mainly use *Boswellia* for domestic, mainly local medicinal purposes. Eritrea (2020) reports the range of the species in its country to be 2,1982 km^2 and annual production of 300 tons (in 1995). Most frankincense was used domestically, thanks to domestic processing facilities, with annual frankincense exports of 35-50 tons. Ethiopia (2020) reports that *B. papyrifera* is the most widely used species for frankincense production but *B. neglecta, B. rivae, B. ogandensis* and *B. microphyla* are used to a lesser degree. Total harvest and export volumes are reported as unknown. Ethiopia reports eight trading companies, but in-country processing is reportedly inexistent. South Sudan (2020) reports harvest and export volumes as unknown, with no known in-country processing. Schippmann (2018 a, b, c) reports estimates of potential production area and potential annual frankincense production in Ethiopia at 2,284,000 ha and 57,100 tons. The production and trade volumes of gums and resins in Ethiopia have been increasing since the 1990s. Between 1998 and 2007, Ethiopia exported about 25,192 tonnes – on average 2,519 tonnes per year, with an average annual increase of 12% – with a total value of USD 34,138,670. According to BfN (2015b), annual frankincense production from *B. papyrifera* in Eritrea is estimated at 450 tonnes. In Sudan, the majority may be consumed domestically. BfN cites a study by the Ministry of Foreign Trade of Sudan and the European Commission, according to which exports declined from 1,726 tons (2001) to 76 tons (2007). Table 4 displays export data for frankincense from these three countries from 2010-2013, using the general tariff code HS130190. Additionally, there is COMTRADE data for Ethiopia (but not Eritrea or Sudan) for export of "incense sticks" under tariff code HS330741, amounting to a total of 22,106 kg between 2010 and 2013 (BfN 2015b). It is not known what percentage of these natural gum and resin and incense stick export volumes are from *B. papyrifera*. Some additional data is contained in the section on utilization and trade of document CoP18 Doc. 66.

Table 3: Reported trade values and exports of products in HS code HS130190 from Eritrea, Ethiopia and Sudan in 2010-2013.

Year	Exporter	Trade Value (US$)	Quantity (kg)
2010	Eritrea	Not reported	Not reported
	Ethiopia	$12,023,242	3,558,403
	Sudan	$1,540,882	1,432,300
2011	Eritrea	Not reported	Not reported
	Ethiopia	$11,312,680	3,445,980
	Sudan	$2,603,764	2,373,070
2012	Eritrea	Not reported	Not reported
	Ethiopia	$10,246,654	2,740,192
	Sudan	$13,727,252	Not reported
2013	Eritrea	Not reported	Not reported
	Ethiopia	$12,184,560	3,268,647
	Sudan	Not reported	Not reported

10. According to BfN (2015b), the Ethiopian Orthodox Church uses about 2,050 tonnes of frankincense per year, with an additional 440 tons per year used for cultural reasons at people's homes in Addis Ababa alone. The major importing countries for exports from Ethiopia are China, the United Arab Emirates, Germany, Egypt and Guatemala (Ethiopia 2020). France, Saudi Arabia, Yemen and Dubai are major importers of frankincense from Eritrea (Eritrea 2020). Main importers of Sudanese frankincense include the United Arab Emirates, Saudi Arabia, China, France, Germany, and Italy (BfN 2015b). According to Schippmann (2018a, b, c), China is the largest market mainly for use in traditional medicines. In Europe and Latin America, substantial amounts of frankincense are used by the Orthodox and Roman Catholic Churches (about 500 tonnes in 1995, BfN 2015b). Similar quantities were imported into North African countries where it is used for chewing. About 50 tonnes are used in Europe (including Germany, France, Netherlands, and Italy) for the production of essential oils and extracts for use in cosmetic, food and pharmaceutical products. According to the section on utilization and trade of document CoP18 Doc. 66 (paragraphs 18 and 19) and Cameroon (Betti 2020), international demand might be rising, due to novel research into pharmaceutical *Boswellia* properties, and increased appreciation of the taxa in personal care products.

11. Among importing States;

    a) Germany (2020) reports that 68 domestic companies are active in trade in frankincense or processed products or do processing of frankincense raw materials in Germany, 35 of which classified as wholesalers. The country plays an important role in processing and distributing gums and resins to other European countries. Between 2010 and 2014, the value of Germany's exports of gums and resins increased by 3.2 % annually on average to EUR 30 million. Most imports are only cleaned and graded before they are exported to Germany. Most value addition by processing takes place in Germany by a small group of importers. These processors have complex industrial production systems for processing gums and resins. The importers receive requests from very diverse buyers, such as manufacturers of food products, aromatherapy products and flavourings and fragrances. Main imports were from Somalia and Ethiopia, but there was no data available about species or traded volumes.

    b) New Zealand (2020) reports that it is not a range State, importing, exporting or re-exporting State of *Boswellia* live specimens. There are no known species of *Boswellia* grown in the country, and import of this genus as seeds, live plants or seedlings is prohibited under New Zealand's Biosecurity Act.

    c) Slovakia (2020) reports to have found two imports of essential oils explicitly labelled as Boswellia or frankincense between 1 January 2018 and 19 March 2020. The countries of export were Switzerland (with country of origin Somalia) and India. Slovakia also reports various online offers in domestic trade for products ranging from dietary supplements for dogs to hemorrhoid gel.

    d) Switzerland (2020) reports imports of *B. serrata* and *B. sacra* and provided an overview of its trade in 2018 (using a general HS code that also includes products of other taxa). Incense constituted 51% of all imports, followed by medicine, food supplements, cosmetics and essential oils. Import volumes across these categories totalled 2,795 kg, while re-exports totalled 6,417 kg.

    e) The United States of America (2020) indicated to mainly import *B. serrata* and *B. sacra*. The primary market in the United States is reported to be for dietary supplements. Based on data provided by four

of its member companies that likely represent the largest share of *Boswellia* imports in the US dietary supplements market, the American Herbal products Association (AHPA 2020) reports that the United States do not do in-country processing of *Boswellia* products, only the manufacturing of value-added finished products from imported *B. serrata* material from India. It reports that approximately 88 tons of *B. serrata* gum resin were imported from India in 2017, and 126 tons in 2018 for this particular market alone. This report seems to put into question the global trade information provided by Brendler (2018), which reports only seven tons of exports of *B. serrata* from India to the United States in 2015-17 (Table 2). An excerpt from the database zauba.com for '*frankincense*' shows very substantial imports volumes. Due to a legally binding definition of the term frankincense in the United States, it seems that imports registered under this term should derive from *B. sacra* and thus be additional to the volumes reported by the AHPA. In an equivalent excerpt for '*Boswellia*', many of the registered *B. serrata* imports seem to originate in India, or to be re-exports from non-range States, in particular the United Kingdom of Great Britain and Northern Ireland. However, the excerpt for '*Boswellia*' also contains numerous entries for *B. serrata* extracts imported from Sri Lanka, where this species is assessed as critically endangered / near extinct. The United States of America assume that these imports originate in India and were then re-exported by Sri Lanka. No response by Sri Lanka was received in response to an inquiry by the Secretariat. As the United States of America are still in the process of compiling trade information, they announced an update at the 25th meeting of the Plants Committee.

12. Very limited information was received on finished products in consumer markets containing *Boswellia* specimens. However, AHPA (2020) reports that a search for the term "*Boswellia*" on 28 March 2020 at the Dietary Supplement Label Database maintained by the US Office of Dietary Supplements and the National Library of Medicine (http://www.dsld.nlm.nih.gov/dsld/) identified 620 individual products as containing this ingredient (all *B. serrata*). This database search also lists products as separate if they only differ in size and form of packaging, includes some duplicates, and does not allow any inference on the amounts *Boswellia* specimens contained in these products. It nevertheless illustrates potential challenges for product tracing and CITES implementation for these value chains, similar to other taxa groups used in pharmaceutical and cosmetic markets (see document PC25 Doc. 30 on *Trade in medicinal and aromatic plant species*).

Information on threats to these species, especially as it pertains to the underlying causes of poor regeneration capability and the impact of harvest on these species
[Decision 18.205, paragraph c)]

1. Substantial information on threats to *Boswellia* populations is contained in document CoP18 Doc. 66 (paragraphs 6 and 23-26). Bongers (2019) collated a summary table of reported threats to the five most commonly traded *Boswellia* species (Table 1), which suggests that the species are affected by habitat loss, grazing, overexploitation of resin and wood, fire, insect damage, and lack of regeneration. All these threats are widely confirmed in responses to Notification No. 2020/010. However, Table 1 also illustrates that no single threat affects all five of these species equally, and that there may be important distinctions between species, countries, and regions. In particular, reports of regeneration problems and lack of younger age classes of *Boswellia* populations abound throughout the available information, but it seems unclear to which degree this is caused by the biological vulnerability of the genus, reduced seed production or reduced seed fertility due to overtapping the trees, or due to sapling destruction through grazing or fires. As summarized by the United States of America (2020), literature seem to suggest that the main threats are habitat destruction, insect damage, and overexploitation leading to shifting harvest. It unclear whether low regeneration is the result of harvest, but rather it would appear that low regeneration is a function of the harsh environmental conditions in which these species are found, combined with the impacts of harvest. However, there are also widespread reports that vegetative reproduction, for example through cuttings, or coppicing of *Boswellia* trees was often easy (Neo Botanika 2020, Oils of Africa, Brendler 2018, Bongers 2019, BfN 2015b), and that at least some *Boswellia* species and populations in India (Brendler 2018, Venugopal 2020), Kenya (Oils of Africa 2020), and “Somaliland” (Neo Botanika 2020) were large, bountiful and well-regenerating.

Table 1: Threats to five *Boswellia* species (Bongers 2019).

	B. frereana	*B. neglecta*	*B. papyrifera*	*B. sacra*	*B. serrata*
Trade (ton yr^{-1})	200	100–300	3,500–4,000	1,400–2,000	~100
Habitat loss	some	yes	yes	some	yes
Grazing	no	yes	yes	no	yes
Over-exploitation resin	yes	no	yes	yes	yes
Over-exploitation wood	no	yes?	yes	no	yes
Fire threat	no	no?	yes	no	yes
Insects	yes	no	yes	yes	no?
Lacking regeneration	no	no?	yes	no?	yes

2. Responses for *B. serrata* and *B. ovalifoliolata* in India suggest limited threats. The company Chemiloids Life Sciences reports some threats due to urbanization, cash crop farming, and fire wood collection, but in very limited areas. Two individual experts see no threats (Suthari 2020, Pullaiah 2020). While regeneration was poor in some places, previously unsustainable harvesting methods had been improved through state regulation and capacity-building among harvesters, and *B. ovalifoliolata* was no longer harvested. Venugopal (2020) confirms that land encroachments, street expansions and grazing are affecting *Boswellia* habitats in some places, but states that a recent survey in 100 forests of Madhya Pradesh had shown plentiful regeneration with individuals of all age groups. Similar surveys were due in 15 other Indian States. Harvests would occur only in less than 10% of the trees throughout India and did not generally pose a threat to the trees’ survival due to sustainable harvesting methods. In contrast, Brendler (2019) suggests that population assessments had been regional and showing highly variable results from healthy populations to clear signs of decay, and that multiple factors (poor seed set, plus grazing and browsing of young trees, coupled to lopping and tapping of larger trees) all compounded each other. According to Brendler, pollinated *B. serrata* only have 10% seed set, and even untapped *B. serrata* trees produce relatively few fruits, probably due to the limited availability nutrients during the flowering period when leaves are absent. Seed viability was poor,

and storage time was limited to six to nine months under dry conditions. However, the biggest long-time concern was habitat loss through farming, poor recruitment of young *B. serrata* trees due to grazing by livestock and reduced seed production due to tapping. Many of India's dry deciduous forests had been degraded to thorny scrub, remaining forests were highly threatened by urbanization, cash crop farming, firewood collection and overgrazing, industry (mining and hydroelectric power production) and population movements (resettlement camps). Brendler also remarks that vegetative tree propagation is possible and practiced, and Venugopal (2020) adds that the plant is known for propagation through seeds, root suckers and pole plants in patches, with observed 80% success rates in some forest divisions.

3. Among the African species, there are very varying descriptions:

   a) For *B. neglecta*, Oils of Africa (2020) is pointing out that, in contrast to other *Boswellia* species, tapping could not induce the trees to produce resin, it was only due to the activity of a borer beetle larvae, which stimulated the tree to produce resin. Harvesting of *B. neglecta* resins is thus from natural exudation. The resins drip down, dry and are usually collected from the ground. The harvesting method of *B. neglecta* thus had no negative effect on the sustainability of *Boswellia* populations as there was no tapping of the trees. Yet, it seems unclear whether the described non-invasive harvesting method applies to all *B. neglecta* harvest. Schippmann and colleagues (2018a) report as threats for this species continuous tapping through the year with no rest periods; grazing of livestock; and cutting branches for fodder in times of drought. Severe droughts also affect the trees directly. Schippmann remarks that it may be inferred from *B. papyrifera* that propagation from rooted cuttings and the production of root suckers are possible.

   b) For *B. frereana*, BfN (2020a) reports that very low rate of germination (<8%) even in hormone treated seeds has been observed. *B. frereana* was, however, easy to propagate from cuttings, with a survival rate between 75-80% of transplanted cuttings observed over a seven-year period. In the Sanaag region where the majority of “Somaliland” and “Puntland” *Boswellia frereana* is found, the main causes of land degradation is reported to be charcoal production (31% of the cases), overgrazing (26%) and other natural causes such as invasive species (24%). Although it was widely accepted that *Boswellia* trees needed three to four years of rest to recover from a full season of tapping, continuous tapping has been observed. Schippmann cites recent field observations and interviews in “Somaliland” pointing out that desperate and irresponsible harvesters are reported as making too many cuts on the trees to drain resin as well as cutting in ways that can and does kill the trees. However, Neo Botanika (2020) considers overtapping in “Somaliland” as being limited to small areas affected from unexperienced tappers. CFESS (2020) suggests that a lack of any recent fieldwork prevents evidence-based conclusions.

   c) For *B. sacra*, Schippmann (2018c) and BfN (2015c) cite four major processes of over exploitation: clearing and conversion of woodlands to arable farming or gravel mining; excessive wood harvesting for fuelwood; overgrazing by livestock, primarily camels, affecting both flowers and seeds and resulting in low germination rates (less than 8%); and improper harvesting and tapping procedures to enhance short-term resin yield, including too many or excessively deep cuts that risk infection of the tree or invasion by parasitic insects, continuous tapping without resting times, and burning off the tree’s bark. As for *B. frereana*, Neo Botanika (2020) and CFESS (2020) voiced doubt of the evidence-based validity and generalizability of these statements for “Somaliland”, which they report to be largely healthy, with easily successful vegetative regeneration. Private ownership of the trees represented protection, since owners and harvesters were conscious that their future livelihoods depend on the trees’ survival. Consequently, areas of overtapping were limited and did not constitute a threat to the *B. frereana* and *B. sacra* populations in “Somaliland”.

   d) The least controversial evidence base is available for *B. papyphera*. Eritrea (2020) reports habitat transformations for agriculture and grazing, and excessive and inappropriate tapping by unskilled labourers that causes low production of non-viable seeds and negatively affects the regeneration capacity of *Boswellia*. Ethiopia (2020) reports that *B. papyrifera* is very sensitive to natural or human interferences and can be damaged easily. The most common factors were windfall, insect attack, termites, fire, improper tapping, clearing and cutting branches by local farmers and trampling and browsing by cattle. No forest management plan was in place; tapping was uncontrolled; and enrichment planting was uncommon. Harvest was considered to affect strongly the sustainability of the populations; and the regeneration profiles of most species were poor because of the open access nature of the forests. Ethiopia made no statement as to whether the observed threats also apply to other *Boswellia* species in its territory. South Sudan (2020) reports a high rate of ecosystem degradation and rapidly declining *Boswellia* populations. There was no supervision of production areas and no management or protection activities. The decline was attributed to ecosystem degradation caused by drought, excessive fuelwood harvesting and overgrazing, land conversion, improper resin tapping methods and insect

damage. Tribal leaders and local community members on the one hand, and outsiders or migrant harvesters were blaming each other for excessive and improper tapping procedures. Cameroon (Betti 2020) reports bark removal for local medicine as the only known use, but also observes regeneration problems, low density of juvenile trees or saplings, and high seed infertility rates. While some populations showed high rates of bark removal, it would not endanger the resource. Literature adds that, in contrast to other *Boswellia* species, lack of regeneration seems to already have started five decades ago. Untapped trees produced three times more viable seeds than tapped trees, but recruitment of young trees into the population was still poor, commonly due to the effects of grazing. Yet, vegetative propagation from root cuttings and root suckers was easy (BfN 2015b, Schippmann 2018c). BfN (2015d) reports that illegal harvest was rampant, since young people sneak in during the harvesting season and take the resin before the legitimate harvesters reach it. Illegal harvesters were collecting resin by making additional cuts onto the bark after the five-month legal harvesting season has ended. Desperate and irresponsible harvesters are reported as making too many cuts on the trees for too long and cutting in ways that kill the trees.

Information on any initiatives to artificially propagate these species or produce plantations of them
[Decision 18.205, paragraph d)

1. The vast majority of *Boswellia* harvest seems to be wild, but no biological challenges to vegetative propagation of *Boswellia* species were reported, and some relevant information on artificial propagation was already provided in paragraphs 4, 7, and 20 of document CoP18 Doc. 66.

2. Eritrea (2020) reports that seedlings of *B. papyrifera* are produced in nurseries and that reforestation efforts through hillside closures, establishment of plantations and planting trees at community and household-levels have been undertaken for the last three decades. Every year, thousands of trees of the species are propagated in nurseries and planted. However, due to overgrazing by livestock, survival rate was minimal. The problem was that there was no follow up of the planted saplings. These statements are confirmed by Bongers (2019), who states that tissue culture techniques are being developed to produce *B. papyrifera* saplings. Planting of branch cuttings was promising – especially when latex of *Euphorbia abyssinica* was applied to speed up root growth – and had been partly successful when applied in livestock exclosures. Enrichment planting with seedlings and small saplings had not been successful so far, possibly due to slow growth, prolonged dry seasons, and livestock grazing, but might be effective if protected from livestock and fire.

3. Venugopal (2020) reports that some artificial propagation initiatives have been put in place by the Indian State Forest department, including seed nurseries, root suckers, stem cuttings and patch plantations, with observed 80% success rates in some forest divisions. These statements are confirmed by Brendler (2018), who also provides some detailed information on pre-treatment of seed, fruit, root, and branch propagules. As of 2020, resin collector groups are entrusted with the collection of seeds for large scale propagation of *B. serrata*. Earmarked plantation areas of 50 ha in each of about 100 designated forests in 23 forest divisions was underway (Venugopal 2020). The company INDFRAG (2020) reports to have planted hundreds of trees in 2019 and that *Boswellia* branches can be easily cut and planted in the soil during the rainy season. The AHPA (2020) reports that one of its members companies obtains *B. serrata* gum resin both from wild populations and from artificially propagated plantations, some of which are 20 years old.

4. In Somalia, first plantations of *B. sacra* were reportedly established in 1982. More recently, preliminary research to establish *in vitro* plant tissue culture for *B. sacra* had been carried out (BfN 2015c). Furthermore, CFESS (2020) reports that *Boswellia* specimens were cultivated in farms, and Neo Botanika (2020) reports that some initiatives had begun but were still at very small scale.

5. Oman has reportedly developed guidelines for sustainable production and harvest, research on frankincense genetics and chemistry, vegetative propagation, plantations, and ground-water-fed frankincense farms. Preliminary results of agronomic initiatives are said to be promising (Bongers 2019).

6. The Secretariat received anecdotal suggestions that *Boswellia* species, presumably in particular *B. papyphera,* were included the ongoing African Great Green Wall Initiative. This initiative was initiated by the African Union and is supported by the UN Convention to Combat Desertification. It aims to counteract soil degradation and desertification in the Sahel zone through the restoration of woodlands. So far, the Secretariat was unable to validate this information.

Existing regulations and ownership structures pertaining to the species, and their habitat, drivers of habitat trends and management measures in place or under development, including sustainable harvest practices
[Decision 18.205, paragraph e)

1. Available information on ownership structures pertaining to the species and their habitat is included in the description of stakeholders close to the harvest (Annex 2, paragraph 1). Drivers of habitat trends are included in the section on threats in Annex 3.

2. Sustainable harvest practices depend on the sourced commodity. It is not clear from the available information whether and how sustainable harvesting methods might also differ between *Boswellia* species. Several sources describe elements of sustainable harvesting practices for *Boswellia* resins to avoid tree mortality and degeneration of *Boswellia* populations.

    a) The importance of resting periods, rather than continuous annual tapping, is repeatedly emphasized. According to BfN (2015a), *B. frereana* trees should be tapped only once every three years. Schippmann (2018b) cites a study stating that the original thickness of *B. serrata* was regained three years after tapping was stopped and recommends resting periods of three to five years after trees are tapped for a couple of years. He also cites another study according to which a healing period of between four and 14 years is advisable in order to attain the full potential for viable seed production in Eritrea. To avoid premature death and poor-quality seeds that are unable to regenerate, Schippmann (2018a, c) states that trees should be rested every five to six years, ideally tapping should not span more than 3 consecutive years. However, in most cases, *Boswellia* trees were repeatedly tapped for up to seven or more years.

    b) Tapping techniques seem to be of crucial importance. Schippmann (a, b, c) quotes manifold studies describing improper tapping techniques that hurt trees or cause fungal or insect infections, including even cases of branch chopping, bark burning, or even tree felling. According to Brendler (2018), a relationship exists between the girth size and gum yield, concluding that for optimum yield of gum, a girth size of above 86 cm for *B. serrata* should be selected so that the gum tapping practices shall not affect the survival status of the species in the natural forest. He also reports that the Indian National Medicinal Plants Board provides detailed guidelines for gum resin collection and post-harvest practices. For example, "*Only a few small longitudinal incisions should be made to collect the exudates and the exposed parts should be treated appropriately to avoid any fungal or bacterial infestation after the exudates has been collected. Incisions, too close to the ground, easily approachable by the cattle and wild animals, should be avoided. The collection container should be designed in a way to prevent rain, bird droppings and any other such possible contaminations*". The best time for gum inducer injection treatment for *B. serrata* trees would be the dry season. BfN (2015b) reports a recommended tapping intensity of six tapping spots per *B. papyrifera* tree for trees of < 20 cm breast height diameter, a total of 12 spots (three spots on each of the four sides) for trees of 20–30 cm breast height diameter and a total of 16 spots (four spots on each of the four sides) for trees > 30 cm breast height diameter.

    c) Muga and colleagues (2014) contains a template for developing sustainable wild harvesting protocols for other indigenous non-timber forest product species in Kenya and East Africa.

    d) Other responses report that locally appropriate tapping techniques were traditionally transmitted from generation to generation in "Somaliland" and India (AHPA 2020, Neo Botanika 2020, CFESS 2020), and that systematic continuous capacity building was provided to tribal people by Indian forest authorities or licensed large vendors (Venugopal 2020, AHPA 2020).

    e) Oils of Africa (2020) mentions non-invasive collection of naturally exudating *B. neglecta* resin in Kenya. It is unclear whether such collection would be biologically and economically feasible for other *Boswellia* species, but responses also suggest that these products might fetch lower market prices.

3. Some *Boswellia* populations are protected in nature protection areas, or species-wide protection, or subject to national management strategies.

a) Forest Authorities in India seem to be heavily engaged on *B. serrata* population inventories, establishing harvesting protocols, and artificial propagation or enrichment planting strategies (Venugopal 2020). The Secretariat notes that India has several conservation programmes for other species, and some *Boswellia* populations could be found in Indian national parks and nature reserves of various kinds.

b) *B. sacra* populations in Oman are covered by endangered species legislation (BfN 2015b). According to BfN, Oman is planning a conservation programme that has recently started with the mapping and monitoring of the populations. DNA sequencing of wild stands of *B. sacra* have been undertaken and *ex-situ* and *in-situ* conservation activities begun in some areas. In 2009, the Oman Environment Society concerned about the rapid decline of *B. sacra* launched a five-year project to assess the status of the frankincense population and to measure the impact of tapping on the health of frankincense trees. Experiments have clearly shown that if damaged trees are fenced off from herbivores they recover rapidly in terms of biomass and young plant regrowth. A 850 hectare frankincense park and 1,263 hectare buffer zone have been designated a UNESCO world heritage site. The establishment of the 4,500 km^2 Jabal Samhan Nature Reserve (JSNR) and its status as a conservation area with Arabia's largest population of Arabian leopards also enable *B. sacra* habitat to be maintained and if a management plan is implemented, to be restored.

c) CFESS (2020), and BfN (2015a) both report that *Boswellia* value chains in Somalia used to be heavily regulated through state monopolies before the civil war, virtually wiping out the private sector. According to BfN (2015a), the breakdown of this system and of State authority in general had fostered competition, driven prices down and enabled unsustainable practices, and the whole issue of sovereignty called into question any attempt to enforce any regulations. Nevertheless, BfN (2015a) cites the draft of a National Biodiversity Strategy and Action Plan for Somalia, which set out clear goals for sustainable management of the country's frankincense resources to be achieved by 2020. It aims at adequately assessing non-timber forest resources; elaborating and implementing sustainable management plans, and, by 2020, putting in place reseeding, exploitation, and marketing strategies, protected pricing mechanisms, and gene and seed banks. However, it does not contain information on the implementation of the plan. BfN (2015a) also states that the private sector in "Somaliland", that has tenure over large areas of *Boswellia* woodlands, has instituted a range of measures to develop and expand sustainable cultivation techniques. CFESS (2020) adds that "Somaliland" has enacted the law on Prevention of Deforestation and Desertification, which specifically applies to frankincense trees. The law prohibits the commercialization or the cutting of plants, which the exception of the commercialization of thirty species, including frankincense trees, subject to the authorization of the Ministry of Environment. Violators are subjected to penalties of 6-9 months imprisonment and/or fines equivalent to 25-125 USD. *Boswellia* ownership was registered under a Gums and Resin Registration System.

d) According to BfN (2015b), *B. papyrifera* is not covered by any endangered-species legislation, but there are populations that are protected inside forest reserves and conservation areas. Outside of these areas, there is a major gap between existing policies and on-the-ground practice of conservation and sustainable use of *B. papyrifera* in all three range States that are commercial exporters of frankincense. These statements seem confirmed by reports from Eritrea, Ethiopia, and South Sudan (all 2020).

e) Cameroon (Betti 2020) reports that the non-timber forest products (NTFP) sector was comprehensively regulated, permitting community members to access them through traditional usufruct rights. However, current processing of *Boswellia* did not follow any established management standard, since the species were not included in the list of 487 regulated NTFPs. Once included in this list in the future, permits would need to be allocated to operators and exporters for this type of product.

Additional observations

1. According to several stakeholders, the possible inclusion of one or more *Boswellia* species in the Appendices of CITES may create implementation challenges for Somalia, including its Somaliland and Puntland regions, whose independent sovereignty is not internationally recognized, and who are therefore not CITES Parties. The Horn of Africa is the centre of diversity of the genus, and Somalia is among the most important exporting countries for several commercially exploited *Boswellia* species (*B. frereana, B. sacra, B. neglecta* mentioned in Bongers et al. 2019, *B. rivae* additionally mentioned by Neo Botanika). The natural gum industry is among the most important sources of foreign exchange through exports, and harvest and trade in *Boswellia* are of high traditional and economic importance to many small-holders. Estimations of the number of persons involved in gums and resins production and trade as a source of income vary from 10,000 for Somalia (BfN 2015a, c) to 70,000 to 100,000 in "Somaliland" alone (CFESS 2020). *Boswellia* populations in Somalia may be affected by threats and suffer from lack of management, but no specific information is available for the Puntland region. The limited information available for "Somaliland" suggests that compared to other areas in North-East Africa, its *Boswellia* populations may be better maintained, and ownership and harvesting protocols may be better established and respected, while species management may benefit from higher regulatory capacity. Some of the harvest from "Somaliland" was recently FairWild certified and could be considered a successful case study of sustainable trade in biodiversity (Neo Botanika; TRAFFIC oral communication; see also document PC25 Doc. 30on *Trade in medicinal and aromatic plant species*). Somalia is subject to a long-standing trade suspension in all CITES-listed species for lack of national implementing legislation (Notification No. 2019/35). Certain stakeholders expressed concerns that even if trade from Somalia was maintained, such as for example by means of improved national legislation and a lifting of the trade suspension, internal frictions and sovereignty disputes would render the collaboration between Authorities of Somalia and "Somaliland" unlikely (NeoBotanika, 2020, oral communication). They questioned whether such a listing would be of benefit to *Boswellia* populations in Somalia and feared that it might lead to the creation of an entirely new sector of illegal international wildlife trade (Neo Botanika, 2020, oral communication).

2. CITES-imposed trade suspensions are also in force for Djibouti since 2004 (Notification No. 2011/010, Notification No. 2018/015), but the Secretariat did not receive information on whether a potential CITES-listing of *Boswellia* species would create concerns such as those expressed by stakeholders in Somalia.

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